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Storage Battery Traction in New York. IT is now definitely announced that a storage battery system is to be installed in this city on the Second Avenue line by the Waddell-Entz Company. A power-house is to be constructed at once, and ten cars equipped throughout with Waddell-Entz apparatus are to be placed in active service. The installation will not be radically different from that which has been hitherto employed in such plants. We are glad that the storage battery is to have another fair opportunity to assert its right to a place among the practical systems of street railway traction of to-day. It has thus far failed to do so, but it is to be operated here in New York under favorable conditions and the result, whatever it may be, will have an important bearing on the future of storage battery traction. It seems rather unfortunate that the attempt should be made on a line which follows the elevated railroad structure where the last objection to its rival, the trolley, is removed, with which, under these conditions, it could hardly compete. That cars equipped with storage batteries can do the required work and do it satisfactorily, cannot be doubted; whether they can do it economically is another question and one whose solution will be looked forward to with interest.

The French vs. the English Language for Telephoning. THE question asked by an inquiring mind that he "did not understand why the same telephone can be used for transmitting different languages," is, of course, received with a smile by the electrician, but if recent reports from France can be relied upon, after allowing something for the love of a Frenchman for his dear language, there may be some truth in the fact that the French language is better suited for telephonic transmission than the English. A press agency using the Paris–London line made some tests to find which of the two languages will give the best "commercial efficiency," as it might be called, an important factor, considering that they pay $2 for three minutes' use of the line. They found that the French language is far better, the difference being attributed to the larger number of hissing sounds in the English language, which are interfered with by the induced currents in the telephone during atmospheric disturbances. They found that they could transmit 576 words in the three minutes' time allowed. The telephonic stenographers have fixed the limit at 400 words in three minutes; the rate of transmission is therefore determined by the stenographers and not by the telephone. For this they charge $5.20, including the fee of $2.00 for the use of the line. In a comparison of the efficiency of the two languages it should be remembered that in the French there are numerous small words, a number of which are frequently jumbled together into one syllable, this jumbling being called euphony, while a large number are not sounded at all, but merely appear in print; besides this, it sometimes takes two words to say something that in English requires only one. The number of words is therefore not a fair showing; in a just comparison the same message should be translated into both languages, and then transmitted, the time of transmission being noted.

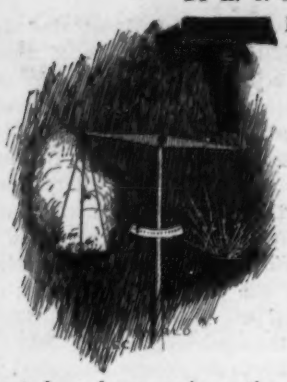
The Future of Street Railways. THE convention of street railway men from all parts of the country at Cleveland, O., to consider the problems that come up for discussion regarding the operation of the street railway, some time ago indicated the probability that it would be, as some of its predecessors have been, very largely electrical in its nature. This feature of the conventions has been more and more prominent as the managers of horse railways have found that the substitution of electricity for horses was one of the best possible ways of increasing the company's dividends. The past year especially has been an important one in placing electric street railway investment on a firm and substantial basis. Investors have turned from other and less promising securities to find—very often, contrary to their expectations—that the field was an excellent one and among the safest to be found for permanent investments. Steam railroad securities have been found to depend for their value upon some very uncertain factors that are entirely outside of the control of the owners of the stock. Among these may be mentioned the weather, the quality and quantity of the agricultural products of the year and the management of competing railroads. There are, however, hundreds of other factors, equally uncertain, that make the steam railroad "security" insecure and more or less of a risk, that do not to such an extent at least affect the dividend-paying qualities of the street railway. The patrons of the road yield their five cent fares with about the same facility in dry weather as in wet, in cold weather and hot alike, and very little decrease is traceable directly to the failure or partial failure of crops. In other words the differences in the way the two kinds of investment are affected by outside conditions are such as we might expect to find where in the one case the revenue is derived entirely from short haul passenger traffic while in the other both freight and passenger traffic, much of it hauled over long distances, contribute to the gross receipts of the road. The substitution of electric motors for horses has done a great deal to improve and dignify the means of transit through city and suburban streets, and this, taken with the fact that it has at the same time made street railways more profitable to their owners, is responsible for the present magnificent condition of the electric railway industry.

Joints in Magnetic Circuits. SOME years ago Prof. Ewing and Mr. Low published an account of their experiments on the effect of a joint in a magnetic circuit, showing that the joint was equivalent to a narrow crevice of air or other non-magnetic material. In a publication by Prof. Ewing, which has just appeared in the London *Philosophical Magazine*, he states that the calculations made at that time concerning the width of the equivalent air gap were not quite correct. After making the correction it appears that the equivalent width of this air space remains practically constant whether the magnetism is weak or strong. By a simple algebraical process he obtains a formula with which the thickness of the equivalent air gap may be calculated, and by applying this to the results published in his former paper he finds that it remains nearly constant instead of becoming diminished as the magnetism is pushed toward saturation, as was incorrectly deduced in his earlier paper. With a joint made of two carefully finished surfaces as nearly perfect as possible, and without applying mechanical force to press the surfaces together, he finds that in one example the width of the equivalent air gap was about .0033 centimetre, and in the second case about .0036. By plotting the values calculated for different parts of the curve and drawing a curve through the results obtained, he finds that this curve is nearly a straight line, being slightly concave in one example and slightly convex in the other, but the deviations from straightness were not greater than may be attributed to uncertainty in the experimental data. He therefore concludes that it is probable that the joint is equivalent to an air gap of sensibly constant magnetic resistance. He furthermore concludes that it is not likely that the metallic surfaces were actually separated to this distance, and he thinks it probable that the magnetic resistance of the joint is due in part to a reduction of permeability in the metal itself at and close to each surface as a result of the influence of surface conditions in affecting the grouping of the molecular magnets. He also shows how to make the correction graphically for joint, in the magnetic curve of a jointless piece of iron; or, vice versa, if the experimental data was obtained from a magnetic circuit with joints, he shows how to correct it to correspond to a piece without joints. To show the effect of the joint in a magnetic circuit in an actual case, he shows that the division of a ring 30 centimetres long into two half rings, abutting against each other with the smoothest possible joints, has the effect of reducing the residual magnetism from 9,000 to 6,000.

Electric vs. Steam Railroads. NO DOUBT electrical engineers often think that the steam locomotive is a very wasteful form of steam engine, and that an electric locomotive would be more economical, because it may be driven by a large economical stationary engine. While this may be the case in many instances, it is probably much less so in the better class of locomotives than is generally believed. Too much, therefore, should not be claimed in favor of electric locomotives simply on account of the mere difference between the coal economy of the stationary and the locomotive steam engine; the chief advantages are to be looked for in other directions. For the benefit of those interested in this subject we publish some instructive data of a standard type of passenger locomotive used in the West, obtained from diagrams made by the author, Mr. C. K. MacFadden. For indicated horse powers of 500 to 1,000 he finds that one pound of coal corresponds to 5.11 ton miles, with an evaporation of 8.2 pounds of water per pound of coal. In an electric road there are three losses, namely, that in the generator, in the line and in the motor, which go toward balancing any difference in the coal economy of stationary and locomotive steam engines, and it is doubtful whether there will be much difference left in favor of one or the other when thus compared, especially when it is remembered that it takes three machines, namely, an engine, a dynamo and a motor, each of 1,000 h. p., to replace a single locomotive engine of that power. The interest on the capital invested in these three machines must be compared directly with any possible coal economy. There are other differences between electric and steam traction, given repeatedly in these columns, among which the chief advantages of the former over the latter are to be looked for. Steam engineers usually give the indicated horse power of locomotives, which figure does not allow for the loss in the engine itself, nor for the power necessary to run the heavy engine alone. In the data given by Mr. MacFadden the engine with its tender represents from one-quarter to one-third of the weight of the whole train; this ought to be taken into account in an efficiency comparison, as it signifies a reduction of 25 to 33 per cent. in the weight efficiency. Surely an electric motor gives a better weight efficiency than this, especially if the motors are placed under each car. Another important consideration is the cost of repairs of a steam locomotive, which appears from Mr. MacFadden's figures to be quite high. This not only represents a direct outlay, but it means also that the locomotive is off duty for a large portion of the time which reduces the earning capacity of the money invested in the locomotive.

Some Tests of Large Steam Locomotives with Relation to the Possible Use of Electricity.

BY K. C. MACFADDEN.



THERE are probably few subjects that interest the electrical engineer in railway work more than that of electricity applied to such service as would be found on our present steam roads.

The subject of electricity *vs.* steam on our large trunk lines has already received much attention by a few interested either in steam roads or in electric railway work, and although many tests have been made on the modern steam passenger locomotive, but few results have appeared in print, and the average reader is probably of the opinion that the motive power of our steam roads now at its best is a very inefficient piece of machinery. The opinions of many of our electrical engineers would lead one to suppose

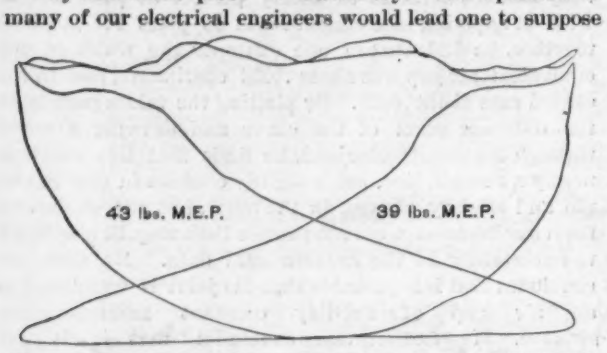


FIG. 1.—INDICATED HORSE POWER, 540; BOILER PRESSURE, 160 POUNDS; MAXIMUM BACK PRESSURE, 11 POUNDS; SPEED, 25 MILES PER HOUR; CUT-OFF, 9 INCHES. FULL THROTTLE.

that locomotive builders have used great ingenuity in building a complete steam plant of immense power for a given weight and size, but have ignored steam economy entirely, and such is undoubtedly the case in many cases that have been investigated.

The question that presents itself to the investigating electrician who has studied the steam locomotive at its best is: Where are the points that make it possible for the electric locomotive, even of an unheard of efficiency, to reduce operative expenses to a less amount than those entailed by the use of the modern locomotive as it is now built?

The writer has had the fortune to take a large number of indicator cards on one of the Western roads from the large

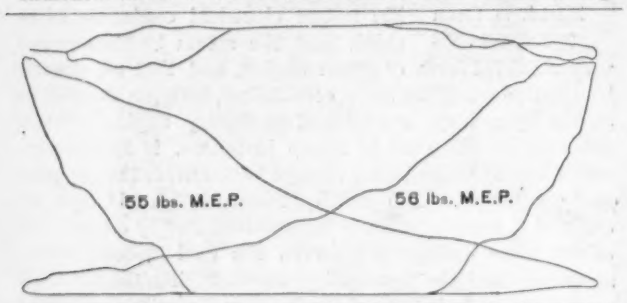


FIG. 2.—INDICATED HORSE POWER, 904.8; BOILER PRESSURE, 160 POUNDS; MAXIMUM BACK PRESSURE, 10 POUNDS; SPEED, 66 MILES PER HOUR; CUT-OFF, 8 INCHES. FULL THROTTLE; 357 REVOLUTIONS PER MINUTE.

ten-wheel passenger engines in their regular daily work. The few indicator cards given show the results that may be obtained from a ten-wheel engine in which some effort has been made to be economical in the use of steam. This engine is the exact duplicate of 20 others on fast passenger work. The weight of the engine with tender is 90 tons, or engine alone 58 tons. The cylinders are 18 inches × 24 inches and the drivers 5 feet 2 inches in diameter. A boiler pressure of 160 to 170 pounds is carried. The engine has a balanced slide valve with supplementary steam ports, and when used with a link motion that allows a cut-off of

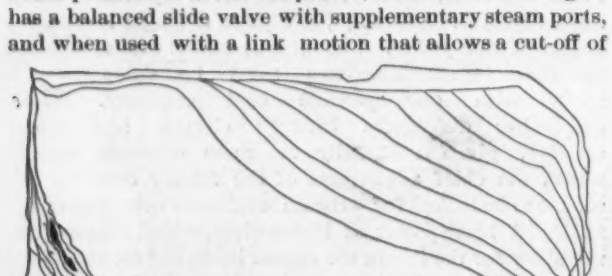


FIG. 3.—ENGINE WAS BEING "HOOKED UP" FROM 22 TO 8 INCHES; BOILER PRESSURE, 160 POUNDS; SPEED, 12 MILES PER HOUR. THROTTLE FULL.

from 5 to 22 inches the cards obtained show that it leaves but little to be desired in the manner in which it handles steam. The cards are as good if not better than those from nine-tenths of the simple expansion electric light engines found in our modern plants. The weight of the engine is enough to keep the drivers from slipping on a good track, with full throttle opening and the cut-off at 22 inches of the 24-inch stroke. It will be seen that with this feature nad a balanced valve it makes it possible to use full boiler pressure at cylinders at all times, and the engineer handles his train with his reverse lever entirely, unless his train is so light that with the earliest cut-off (five inches) he will run ahead of his time given on his running card.

If the experience of the writer is not exceptional, it will be found that the majority of locomotive engineers do not take advantage of opportunities to use steam as it should be used, and many a man will use a one-half throttle opening, and cut off his steam at a twelve-inch point in the stroke, when he might better use full boiler pressure and cut off at an early point in the stroke. As an instance, the fireman on an engine usually handled by an engineer who stubbornly refused to use full throttle, remarked that whenever a man using "full throttle" made his run of 200 miles that he could save two tons of coal. As these engines cover from six to nine thousand miles per month, this item is not a small one, and does not confine itself to coal bills alone, but also increases the boiler repairs to a marked degree.

As a general rule the electrical engineer who has obtained data for a basis of comparison between the relative costs per ton mile on steam and proposed electric roads, has carefully taken in all possible means of engine economy in his plans for his power house, but has ignored the possibility of a steam locomotive being made more economical than it is generally supposed they are. Such a view is very wrong, for during the past year or two great strides have been made in locomotive designs, and the cards here given show plainly the progress one of the many builders has made.

The horse power of the engines tested varied from 500 to 1,000 and speeds up to 70 miles an hour were recorded. This speed was made with drive wheels 5 feet 2 inches in diameter. The card, Fig. 2, taken at 66 miles an hour, indicating 905 h. p., is one of some 20 taken at speeds over 60 miles per hour. The piston spread of the card given is 1.428 feet per minute. The cost of repairs per month per mile is 3.41 cents, which includes the cost of material and labor

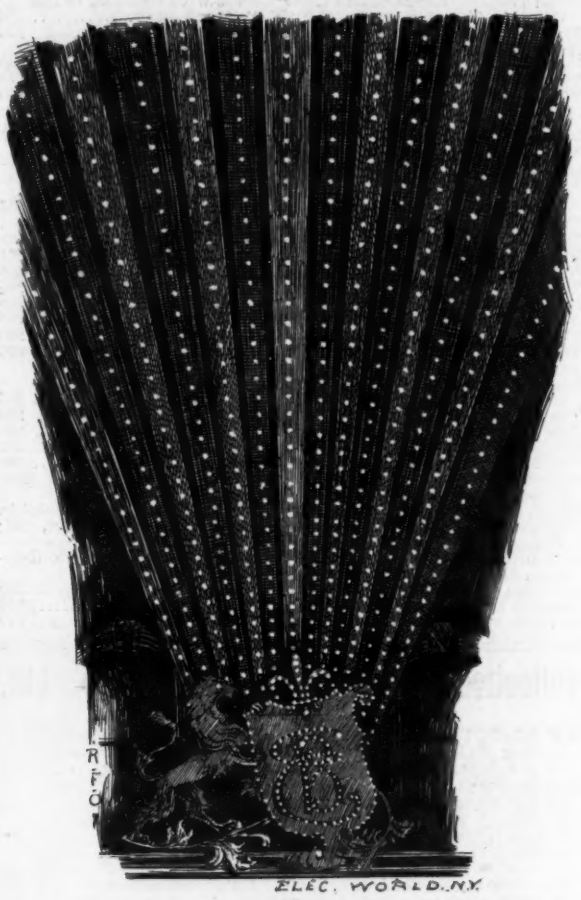
COLUMBIAN FIREWORKS AS SEEN FROM THE OFFICE OF "THE ELECTRICAL WORLD."

necessary to keep the engine in repair year after year. This figure is made up from 12 successive monthly reports on a division that is equipped with none but the heaviest class of motive power, and includes damage incurred by wrecks, etc. The results of a large number of tests show that one pound of coal equals 5.11 ton miles on an average, and that a pound of coal is evaporating from 6 to 10 pounds of water, the average amount on the tests being 8 2 pounds. These figures, taken in connection with the specimen indicator cards given, show a few results in the line of improvement on single expansion engines. The compound locomotive, when handled by competent men, should undoubtedly be able to reduce coal consumption in a marked degree. The engine from which the printed cards were taken made a division run of 202 miles in eight hours, 45 minutes of which was taken up at meeting points with other trains and for meals, leaving the actual time to run the 202 miles and make the regular 45 stops only 7 hours and 15 minutes. The train weight varied with the number of cars from 300 to 375 tons, including engine, and on this division there is a difference of level of 550 feet between terminal points. This engine made from 29 to 33 miles to a ton of coal during the coldest months of the year, and, according to the most accurate information, this figure would be much improved if the correct weight of coal issued to the engine could be obtained.

Are the electrical engineers in general as well posted in regard to what may be expected of steam as they should be?

The Electrical Display During the Columbus Celebration.

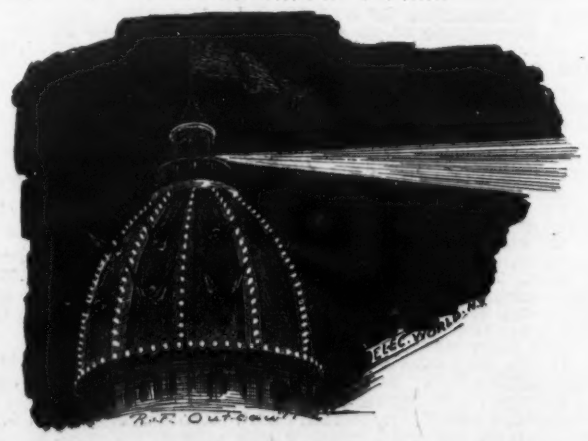
THE announcements made in advance of the Columbus pageant held in this city last week led every one to expect that the electric lighting displays, both in number and variety, would excel anything of the kind ever before attempted. As a matter of fact they were few in number, and, with some notable exceptions, of a very inferior order. The time has passed when even the "dear public" cares for school boy displays of combinations of electric lamps that alternately flash out their rays of numerous colors. A number of years ago it was something wonderful, from the point of view of the general public, to arrange a set or a number of sets of incandescent lamps in combination with switches so that an almost endless variety of displays could be obtained. But a display at the present time must possess something more meritorious



COLUMBIAN ILLUMINATION ON THE FRONT OF EHRICH BROTHERS' DRY GOODS STORE.

than these old and well worn methods of exhibiting the so-called "wonders of electricity."

During the Columbus celebration in the city very few attempts were made to improve on familiar methods of scattering or grouping colored lamps, as the necessity of the case demanded, about the drapery used in the exterior decorations. A few of the displays, however, were more elaborate, and some of these are shown in the illustrations on this and the opposite page. The car "Electra," that was supposed to typify the achievements of electricity, was lighted by 3,000 Edison lamps of one candle power. These were wired in series of six each and current was supplied to them by an equipment of storage batteries furnished by the Union Electric Company. These were arranged to give 85 volts and were of sufficient capacity to furnish 100



ELECTRIC LIGHTING ON THE DOME OF THE NEW YORK "WORLD" BUILDING.

ampères for 3½ hours. This was the only "float" in the parade that was lighted by lamps carried on the car itself, the others being illuminated by the light from lamps of 75 to 100 c. p. carried by attendants alongside of the car. In

these cases reflectors served to throw back the light upon the car and its exhibits, current being furnished by means of flexible cords.

The display of fireworks from the New York and Brooklyn Bridge was a prominent feature of the demonstration, especially combined with the imposing array of electric lights scattered about the East River and the Brooklyn shore. A view of this scene as it appeared from the windows of THE ELECTRICAL WORLD office is shown on this page.

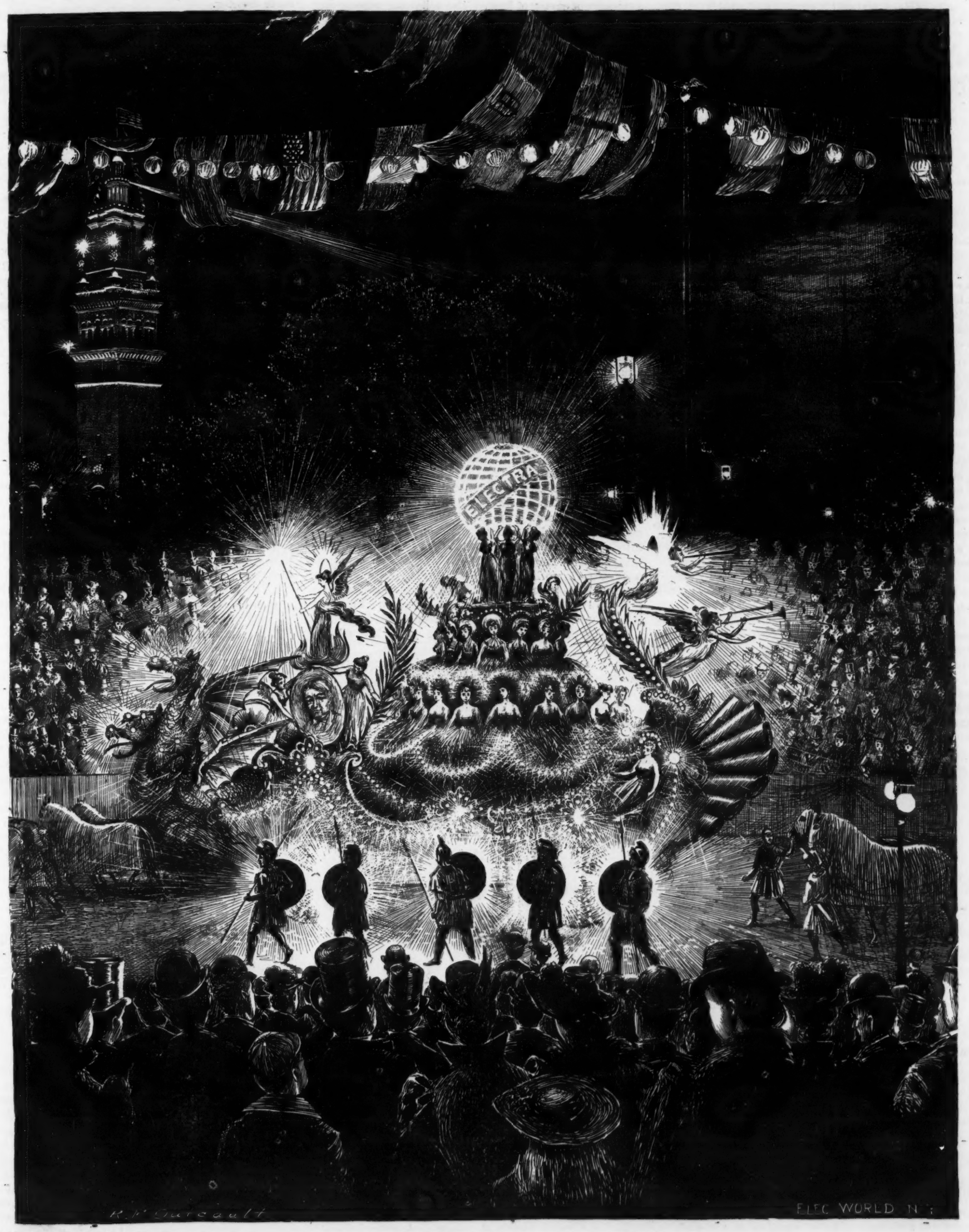
The exterior of the Edison Building was well equipped with light-giving apparatus. On each side were six arc lamps, and on the roof a search light, while across the middle cornice was an artistic display sign which read: 1492—Columbus—1892.

Perhaps as striking an effect as any was that made by the illumination of the dome of the "World" Building, shown in one of the illustrations on the opposite page.

A COLUMBUS ELECTRIC SIGN.

Rows of incandescent lamps were placed along the ribs of the dome and so close together as to give the effect from a distance of one mass of light from a single source.

Of the streets and avenues the best lighted were, of course, Broadway, and Fifth and Sixth avenues. Along these thoroughfares the stores and office buildings were lighted with many extra lamps, both arc and incandescent, and the central stations supplying current for these districts found that they had to carry a greatly increased load all through the two evenings of the parades and far into the night. Along Sixth avenue one of the most prominent features was the lighting display on the front of Ehrich Bros.' dry goods house where great streamers of bunting formed a background for as may rows of incandescent lamps, the trademark of the firm being worked out in lamps and bunting at the centre from which the streamers radiated.



THE CAR "ELECTRA" IN THE COLUMBUS PAGEANT

The Importance of the Station in an Electric Railway System.

BY PROF. E. P. ROBERTS.

N axiom that can be accepted is that "the station" is important, for this is evident, but the same is true of the ground return; in fact, each component of the system is not only important but essential. The comparative value of any part can only be determined by considering its special function and what relation it bears to the other portions.

The function of the station, in an electric railway system, is much the same as that of the heart in the human system. Serious injury to most other members, and even their total loss, can take place, and still life exists and some work can be accomplished, but if the heart cease pumping its energizing current through the system all is still. So it is with the station; leaks may occur, and motors fail, but if the station continue to deliver current work can be accomplished, even though hampered by a crippled member.

The station therefore is of vital importance and of value largely in proportion to its reliability. Reliability is the principal consideration in the design of an electric railway power house, but economy of operation is not to be lost sight of. Economy of the system, broadly considered, includes station reliability, but station economy refers more especially to the cost of delivering to the line the current required. In the design of an electric railway system each factor must be most carefully considered, none can be slighted, and an efficient system results, but there is one consideration specially applicable to the station and it is that in its planning more thought has to be given to the future than when designing any other portion of the system, and it is, to a certain extent, less flexible than any other component part. Line and track work can be added to, modified or removed, and even car equipments can be changed with comparative ease, but that station is best which furnishes current with certainty and economy when first put in operation and to which additions can be made with the least expense and in such a manner that the result is, at any time, a symmetrical and well rounded whole.

In order to achieve such a result it is necessary that the station be properly located, planned for immediate needs and such future probabilities as are deemed advisable, erected not only "in a workmanlike manner," but in the best and most workmanlike manner, and then operated with intelligence and on a broad gauge. There is no worse policy than the "penny wise and pound foolish" one of getting a cheap man to design an electric railway. It is certainly as advisable to have a good engineer as it is to have a good lawyer for their respective railroading abilities, but sometimes one is "retained" for an amount far in excess of the other's "contract." Owing to such niggardly policy being pursued, often unawares, it becomes impossible, commercially speaking, for even good engineers to devote all the time advisable to the personal inspection of conditions and the working out, in considerable detail, of various plans for each possible location of the power house. Such being the case the work must be more or less hurriedly performed and its details left largely to subordinates. In any engineering work of magnitude such a course is, to some extent, unavoidable and does not work injuriously, provided the general plan is properly prepared and the details checked. If, however, the plans be not systematically checked sometimes minor errors will creep in and not be exposed until some time when, although small, they suddenly became of great, even of vital importance. As illustrations of minor defects, consider a case where a by-pass was not furnished for a feed water heater, another where a hole had to be knocked through a wall in order to get a piston out of a cylinder, and another where the boilers were erected before the walls of the building were, and no opening left large enough to admit another boiler. As an illustration of lack of systematic checking, of a somewhat different nature, but likewise resulting in the loss of money, the writer knows of a large plant designed and erected by an able engineer where several hundred dollars worth of work falling under one man's contract was paid for as "extra" to another contractor.

Systematic checking can only follow a prepared system. The labor of preparing a system is amply repaid by not only the feeling of, but the fact of certainty, and also results in a subsequent saving of time. The following scheme suggested to aid the designer in this respect may be very incomplete and can doubtless be advisably modified by any one to better suit his habits of thought. If, however, any one have no habits upon which he can, from experience, rely, it may be helpfully suggestive; indeed the very act of cutting it to pieces may be of benefit.

The "design of the station" might be taken to include its location and the considerations leading thereto. If such be the case it is evidently necessary:

1. To have a map of the proposed route and the probable additions thereto. 2. To construct a diagram, or table, showing the power required on the road, and each section thereof, for the traffic for which it is designed to make provision. 3. To ascertain the various possible locations of a power house. This being done, the advantages and disadvantages of each site can be weighed one against the other; central location, no water for condensation and cartage of coal weighed against the choice of a location not quite as central, having a side track from one of the roads for coal; or still another location with two adjacent railroad tracks from which to receive coal, possibly of not much advantage at the present day; and that again against a water front with free water for boilers, for condensation, navigable water facilities for carrying coal, and unlimited dumpage, or cheap transportation for ashes. The disadvantage of increased distance as it affects the line must be weighed against cheap power; many elements essential in each case do not need separate consideration, but one exists which must always receive most careful study—it is the character of the ground for the foundations. Naturally the comparative costs of the ground and of the building will be considered.

The purpose of this paper is not, however, to prepare an analysis of the factors entering into the question of location, but to present a systematic scheme of analysis, together with the philosophy of the same, for consideration after the location is fixed. When the location is fixed the general design has probably been already sketched out; no one feature is worked up in detail until a comprehensive view has been taken. A systematic chart has its value principally in checking after the planning, in order to be sure that no important details have been omitted.

The plan of thought upon which the system is based consists in:

1st. The division of the station as a whole into its main functional elements and the location thereof.

2d. Considering what are the necessary adjuncts thereto: *a*, those of a structural character, such as foundations; *b*, those of a mechanical character, such as oil pumps for the engine.

- STATION..
  - Steam plant
    - Boilers
      - Foundation.
      - Setting.
      - Stack.
      - Water.
        - Source.
        - Pumps and injectors, valves and gauges.
        - Heaters.
      - Sediment
        - Blow off.
        - Mud drum.
      - Steam
        - Steam pipe and valve to heater.
        - Entrained water, separator.
      - Fuel
        - Placing in building.
        - Placing in boiler.
        - Removal of coke and ashes.
        - Removal of soot.
      - Air — Supply to surface.
    - Link.
      - Piping and valves.
      - Coverings.
      - Drains and drips.
      - Supports.
    - Engines
      - Foundation.
      - Steam to cylinder.
      - Oil to cylinder.
      - Steam from cylinder.
      - Water from cylinder.
      - Oil to engine.
      - Oil from engine.
      - Engine indicator.
      - Steam to condenser.
      - Water to condenser.
      - Water from condenser.
    - Connecting links
      - Belts.
      - Shafts — Foundations. Lubrication.
      - Pulleys.
  - Electrical plant
    - Dynamos
      - Foundation.
      - Lubrication.
      - Insulation.
      - Governing devices.
      - Measuring devices.
      - Safety devices.
    - Wire
      - Dynamos to switchboard.
      - Switchboard to line.
      - Track to dynamo.
    - Switchboard
      - Distribution devices.
      - Dynamo governing devices.
      - Dynamo measuring devices.
      - Feeder to measuring devices.
      - Safety devices.
      - Cut-out and lightning arrester.
  - Building
    - Weatherproof.
    - Fireproof.
    - Ventilated.
    - Light.
    - Provisions for cranes or other strains foreign to its functions as a shelter.

3d. What goes into the machine in order to vitalize it; what provision is made for its entrance and exit, and the controlling and measuring devices therefor.

4th. The connecting links.

Possibly greater subdivision is desirable, in which case the following nine considerations may serve as an example of an elaboration of the general scheme:

1st. What are the main transformations of energy, and in what mechanisms do they take place?

2d. What goes into and out of each of such mechanisms, and what provision is made: *a*, for controlling; *b*, for measuring the same?

3d. The connecting links between each element and the one preceding and succeeding?

4th. The location of each functional element and the necessary adjuncts thereto. This includes *a*, its location in space; *b*, the location of the foundation, or other structural adjuncts; *c*, the placing in position and the provision to be made therefor.

5th. The location and construction of the connecting links, the nature of which was considered in 3.

6th. The connection of similar elements to the extent desired.

7th. The disconnection or throwing out of commission for repairs of each element and each adjunct thereof to the extent desired.

8th. The dominating thought—reliability.

9th. The sub-dominant thought—accessibility; *a*, for operation; *b*, for repairing.

As before stated, when the location is fixed the following data are given and their dependent variables have had their values determined:

A. Current output curves, showing minimum, average and maximum loads for usual conditions and any special conditions of loading to be provided for.

B. Subordinate to *A* are the units of the dynamo, engine and boiler, and again subordinate to these and to *B* is the character of engine, high or low speed, high pressure, compound or condensing; shafting, single belting or direct connecting.

The problem then becomes one of how best to install certain apparatus. It should be installed in such a manner that it can be operated reliably and at a minimum cost for installation and operation, and so that additions can be readily made without interfering with existing arrangements, and which, when completed, will produce a larger station also equipped to operate with the maximum economy. If such a result be obtained the designer can truthfully state that he has "done his duty in that station to which," etc.

In order to operate reliably and economically it is essential that each part be so installed as to operate, as nearly as may be, with its best efficiency—that it be accessible for the regular manipulations necessary for its operation and also for repairs, and that its failure to act does not jeopardize the whole station; also that the action designed to be simultaneous be as far as possible controlled by one man.

All these thoughts take place simultaneously in the brain of the designer, but each element can be examined individually when criticising the design.

Following out the scheme, the station is divided into three main divisions: 1st, prime movers; 2d, electrical apparatus; 3d, building.

The furnishing of power being usually accomplished by steam engines, the first division may be called the steam plant. The principal subdivisions under this head are: 1st, boilers; 2d, engines. Next is considered the setting and foundation for the boilers. The boilers being placed, the next question is, how do they obtain their energy? and the answer gives rise to three subdivisions: fuel, water, air. Then follows each element from where it comes under the jurisdiction of the station to where it has done its work; the latent energy has been developed and all products disposed of. Considering first the subject of the fuel: if coal is delivered it must be unloaded by some means, weighed (?), stored, weighed again (?), given to the firemen, placed under the boilers, burned, and the result is—ashes and clinkers, to be withdrawn from the furnace, then withdrawn from the ashpit, and finally removed from the station, and soot to be removed from the flues. The coal and the air together generate hot gases, which may be divided into two quantities: first, that to be utilized, (*a*) in heating the boiler, and (*b*) in creating a draft; secondly, that which is wasted, (*a*) in heating the boiler setting, which is unavoidable, and (*b*) by escaping out of the chimney, which is largely avoidable by proper proportioning.

At this point the writer desires to digress slightly from the scheme. The object of combustion being to produce heat, the designer of it aims to produce it economically. The object of the heat being to evaporate water, the design provides means to accomplish it with as little waste as possible. In order to prevent waste it is necessary to know the channels through which it takes place (exclusive and inclusive of the fireman) and as far as possible guard against them. This is the end where economy commences and where saving counts for most, even if the attendant gods or demons do look rather dingy and do not wear quite as large and highly polished brass collars as the Cerberus or purchasing agent, who rushes around to get a reduction of five cents per ton on coal (no matter what kind of coal, so long as it is "coal"). Savings after the steam is produced are advisable, but they are as discounts on discounts. No business man believes 20 and 20 per cent. off to be as good as 40 per cent. straight; but if, when on a

board of directors, he advise cheap firemen, "he gets there all the same." Lately it has become quite the fashion to expatiate along this line, and the writer desires to keep in line with his confrères; he also believes that too much has not yet been said on this score.

Having now considered the subject of the fuel, the next subject is that of the water. The water being delivered to the premises must be measured, pumped, passed through a heater to the boiler. All the apparatus for these several purposes must be so piped as to allow its connection with others of the same nature, and also "by-passed." Flanged couplings, rights and lefts, or other devices, should make it possible to disconnect without handling length after length of pipe in order to get a starting place. The water being obtained, all will not pass off as steam; there will be more or less sediment. Provision may be made for taking the greater portion out before it reaches the boiler, or by blowing off afterward; in either case the necessary connections must be made. If condensing engines be used the supply of water, therefore, must be considered.

After the consideration of the subjects of fuel and water, comes that of the air. The fire and ashpit doors, and settings in some designs, control the admission of air.

The steam having been produced it passes through the following connecting link of piping: 1st, boiler valve and pipe; 2d, heater with valves; 3d, mains or mains with valves; 4th, supports; 5th, coverings; 6th, drains; 7th, separator (?). The steam being now delivered to the engines, that division comes next, namely, the engine and its foundation.

Steam having now been delivered to the engine, provision must he made for its exit, and the exhaust pipe should now be followed, through feed water heater, or through condenser, till the steam has been discharged. It is not only the steam which must be taken care of; but water also enters and leaves the cylinder and provision for its discharge must be made. Oil also must enter the cylinder and provision must be made therefor. Oil must also be fed to all moving parts, and, as far as possible, it should be caught, filtered and used again.

From the engines the step may be direct to the dynamos, but usually a connecting link will intervene; sometimes it is only a single belt, in other cases a system of shafting with friction pulleys, idlers, tight and loose pulleys, hollow sleeves and clutch couplings, sometimes requiring massive foundations and often creating a demand for an elaborate system of piping for lubrication.

This brings the designer to the electrical section. With the sources of loss in the dynamo he has nothing to do, with the exception that he must provide firm foundations and belts under proper tension. In most cases even the relative position of all the controlling, measuring and interchanging devices is fixed, being on a station switchboard, and the station designer has merely to provide passage for the wires to and from the switchboard to the dynamos, lightning arresters and earth. Although the work in this section is mainly one of location, nevertheless it is of great importance that it be properly done, and to so do he must understand the function of each part, and how and by whom it will be operated when the station is running.

With two men in a room and three manipulations which must be made simultaneously, it is advisable to make it possible for one man to operate at least two of them.

The apparatus all being placed, the last main division is reached, namely, the building. For a street railway power house it is advisable, and usually possible, to have all the parts on one floor. This being the case, the building becomes merely a shelter, having more or less architectural pretension. As far as the welfare of the station is concerned its function is fulfilled if it be weather-proof, fireproof, well ventilated, light, well floored and a tight partition erected between the engine and boiler rooms.

In some cases the design will have to meet certain structural necessities in the way of provision for overhead cranes, etc., but in the main the building is of necessity only a shelter. Although this is so, there is a growing desire to house in a dignified tenement that which is the heart of the system. The advisability of erecting fireproof structures makes it necessary that rather expensive materials be used for construction, and it generally costs little, if any, more to have the proportions architecturally correct and the design fitting and pleasing than to have the reverse. Some stations are admirable structures. How far money spent in adornment is wise is a question for the directors; but it is certainly true that reliability is dependent upon cleanliness and general care, and that these in turn are dependent upon the pride of the attendants as well as, possibly as much as, upon wages or threatened discharge, and they, in turn, are at least influenced by environment.

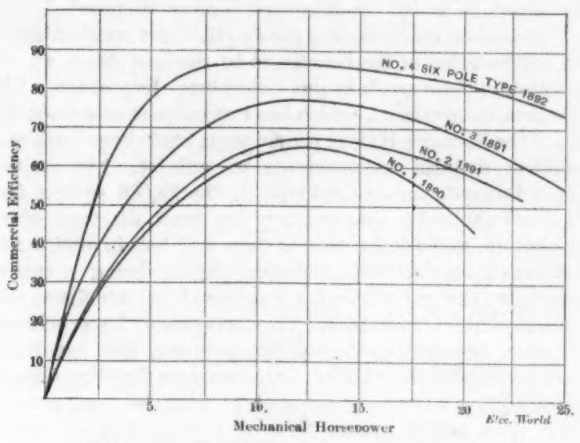
The following chart shows graphically the working out of the scheme. It would be too complicated if carried out in greater detail.

The New York Electrical Society.

The 146th meeting of the Society will take place at Columbia College on Wednesday, Oct. 19, at 8 P. M. Prof. F. B. Crocker will deliver an address on "What Europe is Doing in Electricity," in which he will describe the electrical establishments which he visited during his recent trip abroad. Prof. Crocker will indicate especially the differences between our methods and those in vogue abroad, illustrating his remarks by the exhibition of photographs.

The Short Gearless Motor.

The accompanying cut gives some interesting information in regard to the efficiency of the new Short gearless motor, which was illustrated and described in The Electrical World of Oct. 15, 1892, as compared with the types of gearless motor previously brought out by the Short Electric Railway Company. The curves show the efficiency at various horse powers, No. 1 being that of the first experimental machine, No. 2 that of the first



EFFICIENCY CURVES OF SHORT MOTORS.

commercial machine, No. 3 that of the second commercial machine and No. 4 that of the new six-pole gearless which has just been brought out. It will be seen that the new motor possesses a much higher efficiency than any of its predecessors.

The Sperry Motor.

The equipment which the Sperry Electric Railway Company, 29 Broadway, New York City, is putting upon the market consists of a single motor, flexibly mounted on the truck, having a hollow shaft through which runs the pinion shaft, driving both axles through bevel gears. Between this pinion shaft and armature shaft is a flexible gear. The motor is a 40-h. p. single reduction, with slow speed armature. The gears are of a particular design, with broad face and very strong. The housing for these gears forming the bearings for the pinion shaft are likewise very strong and of special design, and have proved, in practice, to be admirably adapted for the purpose. The gears on the original equipment running to-day at Youngstown are in splendid condition and have not been running in oil, though all equipments now made have gear covers, allowing the use of oil on the gears. By this method of flexible support and flexible connections the maximum tractive effect is obtained with a minimum expenditure of power, giving a single 40-h. p. motor with one armature instead of two 15-h. p. motors having two armatures, throwing the total weight on the wheels for traction and having the minimum weight on the wheels without springs.

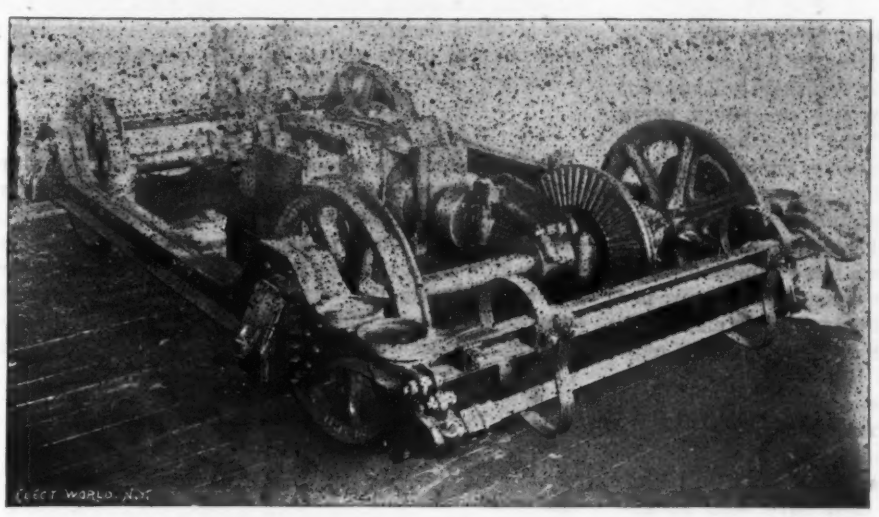


FIG. 1.—THE SPERRY STREET CAR MOTOR AND TRUCK.

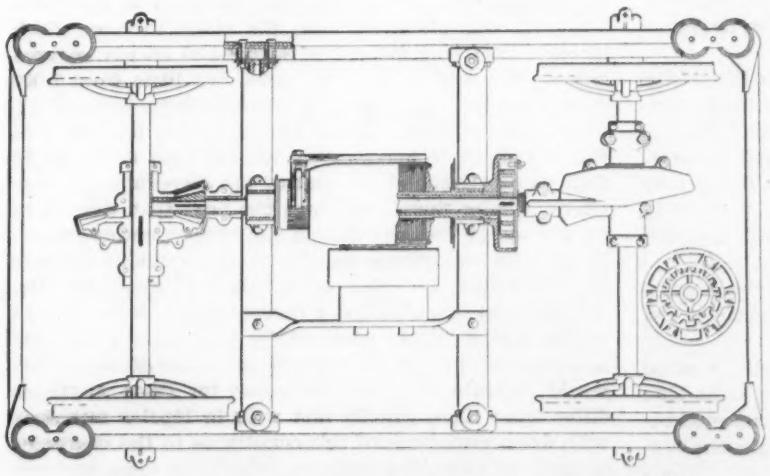


FIG. 3.—PLAN OF SPERRY MOTOR AND TRUCK.

Economic Construction of Field Magnet Frames.

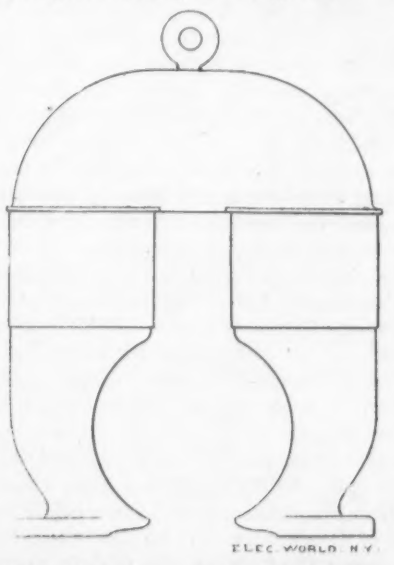
BY A. D. ADAMS.

The aim of the constructing engineer is to adapt natural products and forces to the wants of civilization with the least expenditure of materials and labor. It is of the highest importance that the qualities of the materials to be used for a given purpose be known; else, the work may be too costly on the one hand, or fail of its object on the other. Of no branch of engineering is this more true than of the electrical. The "ohmic properties" of the more common materials with which the electrical engineer has to do have long been well understood, but accurate knowledge of the magnetic properties of cast and wrought iron is of quite recent date. This knowledge is especially important because of their wide use in the field magnets and armatures of dynamos. The researches of Hopkinson, Ewing and Rowland show that a magnetization of 100,000 lines per square inch in wrought iron, or from 40,000 to 45,000 per square inch in cast iron, requires the same expenditure of magnetizing force per unit of length, and that with the lower degrees of magnetization common in the field magnets of dynamos, the difference in magnetic properties between the two metals is much greater. From the above it is evident that if equal amounts of magnetizing force are to be expended per unit of length in a field magnet composed partly of wrought and partly of cast iron, the section of the cast iron must be at least somewhat more than twice as great as that of the wrought iron. In many dynamos the field magnet cores are of wrought iron, and the yokes and pole pieces of cast iron. If it is thought best to expend more magnetizing force per unit of length in one part of the magnet frame than in another, economic construction requires that this part be the magnet core, as a saving of copper is thereby effected; while, if the yokes or pole pieces are designed for a higher expenditure of magnetizing force per unit of length than the magnet cores, the only saving is a slight one in cost of iron, which is more than counterbalanced by the increased cost of copper.

In numerous makes of American machines the cast iron yokes and pole pieces have only from 1.3 to 1.6 the section of the wrought iron cores. As a result of this construction the cost of copper for field magnet winding, also the leakage of magnetism, are considerably greater than they should be.

FIG. 2.—DETAIL OF MOTOR.

The use of cast iron in proper quantities for the frames of dynamos gives them a bulky, and, in some types, unsightly appearance, which will perhaps account in some cases for its use in insufficient quantities. But the writer is aware from conversations with various dynamo builders that the relative magnetic properties of wrought and cast iron are often misunderstood. In England the relative values of wrought and cast iron seem to be better appreciated by dynamo builders, and several of the best makes have magnetic frames composed entirely of wrought iron, while others use cast iron only for the yoke or base, and make it very heavy.



FIELD MAGNET CONSTRUCTION.

In the line of dynamos and motors designed by the writer, and now manufactured by the Commercial Electric Company, Indianapolis, Ind., the disadvantages incident to the use of cast iron in the magnetic circuit have been avoided. The field magnets of these machines are composed entirely of wrought iron and a grade of cast

steel having nearly equal magnetic properties with it. This construction involves less copper for magnet winding, less magnetic leakage, less weight and a higher efficiency, and a more sightly, desirable machine. In the small sizes, magnetic frames are cast in one piece and the coils slipped on over the pole pieces, thus avoiding all joints, and saving considerable labor. It is believed that the substitution of cast steel for cast iron in magnet frames represents a substantial advance in the art of dynamo building.

The Induction Motor: Who Invented It?

BY JOHN F. KELLY.

In THE ELECTRICAL WORLD of Oct. 8 Mr. Tesla discusses the question of the relationship of the type of induction motor recently described by Mr. Rankin Kennedy to that invented by him. The question is an interesting one and I should be glad to discuss it if Mr. Tesla had not rendered it impossible by the position he has assumed. A technical discussion cannot be carried on where one of the parties begins by imputing motives, and a claim of legal ownership is not to be settled in the technical press.

I must therefore limit myself to asserting on behalf of Mr. Stanley:

1. That he is the original inventor of the type of motor described by Mr. Kennedy.
2. That it is distinct from the Tesla motor.
3. That it is not necessary to be a partisan of the "armature reaction" theory to perceive the difference, as in his perfected form armature reaction is practically destroyed.
4. That he has developed the motor until it is to-day practicable and commercial, the best alternating current motor.

Electricity at the World's Fair.

(From Our Special Correspondent.)

The Department of Electricity is ahead of all the other departments of the Fair in that all the space at its disposal has been assigned to exhibitors, and Prof. Barrett is now ready for the actual installation of exhibits, which, under the rules of the Director General, may begin Nov. 1. The assignments were approved by Director General Davis this week.

Approximately 700 exhibitors have been provided for in the American section, and the advices to the department from foreign commissions indicate that there will be about 300 foreign exhibits. With one or two exceptions, every American firm and individual of any prominence in the electrical business has applied for space, though of course not all of them will be accommodated. A system of allotment was decided upon by the department several months ago, which has given very general satisfaction.

Prof. Barrett felt that there were a large number of small exhibitors who, though entitled to consideration, were not strong enough to occupy space individually in a manner to meet the high standard set by the department. The only way to give satisfaction, both to the exhibitors and the department, was to mass together several of these small exhibits which could be well harmonized and allot a sufficient area to them in bulk to meet their individual requirements and then let them fit up the space jointly. In this way a dozen exhibitors in some cases have been advantageously cared for in an area 30 feet square, when if separated they would have required three times the space. By following out this general idea to its ultimate conclusion nearly all of the 700 applicants have been provided for in less than 200 exhibition spaces.

No electric belt or so-called "electro-medical appliance" concerns will have space in the department building. Chief Barrett assumes that it is a part of his duty to see that only legitimate applications of electricity are countenanced by the department. Under the general rules of the Exposition, no patent medicine or "secret nostrum" affairs can be given space, and Chief Barrett has classed the "electric belt" people under these general heads. More than 100 of these applications have been before the department, and a decision unfavorable to them has just been reached. Such a decision as this is in line with the recent stand taken by the English electricians and electrical journals in the bitter war which has been waged for some months.

The exterior and interior decorations for the Electricity Building have been agreed upon by the Chief of the Department, and the Director of Works and his staff. The exterior of the building will be terra cotta in general effect, the only departures from this being the facades at the four main entrances, which will be lemon yellow, with lively borders and figures in fresco. Hidden lights will heighten the effect of the yellow, which resembles gold at night.

For the towers at the corners of the building the decorations will be restricted to lighting effects in incandescent and arc lamps.

The colors for the interior of the building will be stone color or gray for the walls, and three shades of light blue for the ceilings and pillars. These colors were selected because of their neutrality. All the foreign commissions having space in the building will wish to make special characteristic decorations of their own and these colors can be made to harmonize with almost anything. Moreover, shades of yellow were about the only other colors left to select from for interior finish, and it was thought that the glare under brilliant illumination such as the building will be subjected to would be injurious to the eyes of visitors.

It has been finally decided not to place the medallion of Alfred Vail with that of Prof. Morse upon the electricity uilding. The officers of the exposition have been annoyed by a controversy brought about by the family of Alfred Vail, in contending that he and not Morse invented the telegraph, and those who have given the matter attention do not feel like reopening the history of the great discoveries. They seem to think that contemporaneous writers knew pretty well who discovered the telegraph, and besides this, Secretary Hornsby has just found an old scrap book, once the property and companion of Prof. Morse, and which contains an almost unbroken record of the great discoverer's work, dating as far back as 1821. The book also contains a great number of autograph letters written by Morse, in which the telegraph is often discussed.

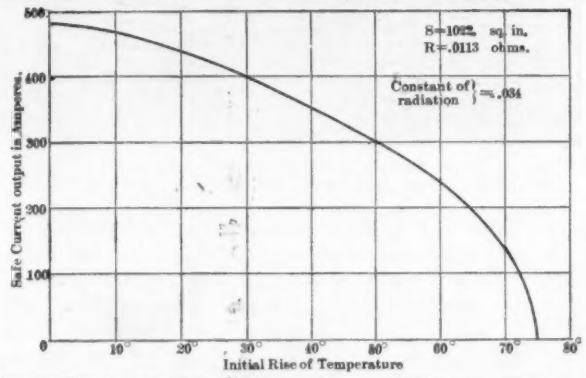
Foreigners, all excepting the English, are awakening to an appreciation of the benefits to be derived from an exhibition of their goods at the Columbian Exposition. The German Commission, which has been almost at a standstill since the Siemens-Halske people went back home without making definite arrangements to exhibit, has notified Chief Barrett's department that all the 20,000 square feet of space allotted to that country has been disposed of to exhibitors, and ask for several thousand feet in addition to accommodate a splendid historical display being prepared jointly by the government, a number of private firms, and several of the universities. France seems to have eclipsed all other countries in the section, however, and has made such a splendid showing of her intentions that the department officers have been induced to give her commission more than 25,000 square feet of space. The successful efforts of France are largely due to the fact that the government pays a good round share of the expenses incident to exhibition, especially in the electrical section.

The electrical building will be supplied with light and power on a plan entirely independent of the general power plant. The building has been divided into equal portions, and each of the power and light supply companies will be given one of these sections to light and supply with motive power for the operation of machinery. Steam will be furnished free by the department in return for the plant and service for the general arc light illumination, and where other exhibitors are supplied a charge will be made sufficient to cover the cost to the exposition and the special exhibitor furnishing the service. The plan secures light and power to electrical exhibitors at prices much below those charged by the exposition in the other departments.

Heating of Armatures.

BY HARRIS J. RYAN.

Mr. Rechniewski's recent contribution to the literature of this subject is of great interest and value to every one who is engaged in the design and construction of electrical machinery.* The writer has directed an investigation of this subject in the engineering laboratories of Cornell University during the past year. A brief statement of some of the results obtained thus far is made with the hope that still further attention may be called to the



CURVE SHOWING RELATION OF INITIAL RISE OF TEMPERATURE TO SAFE CURRENT OUTPUT.

subject, and that others may be induced to communicate data and results already obtained through similar investigations.

An examination has been made of many drum armatures of different makes in this country. They had no internal ventilation. All heat produced in the wires and core was given off from the outer surface, which in each case was formed of shellacked cotton covered wires. The surface velocity varied but little from 3,000 ft. per minute, while the poles covered from 70% to 80% of the circumference of the armature. On long runs at full output their temperature usually rose to 70 or 75 degrees centigrade above that of the surrounding atmosphere. Under these conditions the heat that was given off per square inch per degree rise of temperature above that of the atmosphere was found to average at the rate of .034 watts. For this same class of armature Mr. Rechniewski has obtained a corresponding value of .018 watts. Other values obtained by him from multipolar machines are in fair accord with our value of .034. This would indicate that the conditions for these machines differ from those usually met with in bipolar machines with drum armatures of this country as to the character of the heat dispersing surfaces, velocity of these surfaces or the velocity of air currents over them, and the extent to which the armatures were inclosed bythe poles and frame.

At the present day the makers of this country are giving a great deal of attention to the improvement of the quality of the iron put into the cores of their armatures. Practical tests are made of the heat produced by each available sample of iron under conditions alike as to dimensions of core discs, magnetic density and speed of rotation. In this way the best obtainable iron for the purpose is selected. As a reward for their trouble they find that the output of their machines may be considerably increased over what it had been when iron of excellent mechanical properties but indifferent magnetic properties was used. It is of interest, therefore, to note the relation in a given armature of the heat developed in the core to the allowable current output. The present practice of this country indicates that for armatures of ordinary construction dynamo makers consider 75° centigrade a safe, allowable rise of temperature above that of the surrounding atmosphere. The normal output of current is then determined as that which will not produce in conjunction with the heating of the core a rise of temperature of more than 75° centigrade in a given armature operating at normal pressure. An armature that is operated for some time at normal pressure and no load has its temperature raised a certain amount in order to liberate the heat produced in its core. Let us refer to this as the initial rise of temperature. Then if T be the initial rise of temperature, S the surface of the armature in square inches, and R its resistance in ohms, we shall have for any armature the following relation between the safe current output and the initial temperature:

$$C^2 R = (\text{constant of radiation})\, S\, [75^\circ - T.]$$

It is in a more convenient form when written

$$C = \sqrt{\text{constant of radiation}\ \frac{S}{R}\ [75^\circ - T.]}$$

It will be remembered that for drum armatures as generally made in this country the constant of radiation is equal to .034. The accompanying diagram shows at a glance the exact nature of this relation.

Each improvement in the qualities of the core lowers the initial temperature of the armature a certain amount. The actual increase in the safe current output due to an improvement of the iron in the armature core is something that is entirely definite. The curve in the diagram is given for a drum armature of a well known two pole generator made in this country. Four years ago, when this armature was designed and first built, its initial temperature was 50° centigrade, and its normal output of current was rated at 300 amperes. To-day with a core made up of the best iron that the market supplies this armature has an initial temperature of only 30 centigrade, and the rating of the safe current output has justly been raised from 300 to 400 amperes. The degree of lamination of the iron of these armatures as built four years ago was as great as that applied now.

Mr. W. E. Goldsborough, of the senior class in electrical engineering at Cornell, has made a series of determinations of the heat produced in drum armature cores used in bipolar machines of various makes and sizes for inductions varying from 1,000 to 6,000 lines per square centimetre and speeds from 200 to 2,000 revolutions per minute. His average results are expressed by the following empirical formula, which is a modification of the one proposed by Mr. Steinmetz for hysteresis produced by cyclic changes of induction:

$$\mathbf{H} = \left[.004 + \frac{\text{speed in } r\ p\ m}{300{,}000} \right] \mathbf{B}^{1.6}$$

H = the core loss in ergs per cubic centimetre per revolution.

B = the induction in lines per square centimetre.

Those who undertake the design and construction of the large generators for light and power purposes, for which there is now a growing demand, frequently meet with disappointments. Large armatures of new designs are frequently found to heat to an extent that was not anticipated, and the necessary changes that must be made before their performance is satisfactory are expensive and tend to destroy confidence in the feasibility of introducing needed and useful improvements without ultimately incurring great expense. All this would be avoided if the initial rise of temperature of every iron cored armature of a new design were accurately predetermined.

* THE ELECTRICAL WORLD, May 14, 1892.

Winter Lectures of the New York Electrical Society.

The managers of this society have arranged for the following course of lectures for the coming season:

1. The Arc Light (with experiments), by Mr. R. S. Dobbie.
2. The Telephone (experimental), by Mr. J. J. Carty, Electrician Metropolitan Telephone Co., New York City, and Mr. F. A. Pickernell, Engineer American Tel. and Tel. Co. (Long Distance Co.).
3. How to Lay Out and Wire an Isolated Lighting Plant, and How to Operate It, by Mr. August Noll, Superintendent New York Electric Equipment Company.
4. Primary Batteries (with exhibit of various batteries), by Mr. G. d'Infreville, late electrician Western Union Telegraph Company.
5. Electricity in Medicine (experimental), by Dr. William J. Morton.
6. The Progress of the Year, by Mr. Joseph Wetzler.
7. What Europe Is Doing in Electricity, by Prof. F. B. Crocker.
8. The Magnetic Field, by Prof. E. J. Houston.
9. Insulation and Surface Leakage (with experiments), by Dr. J. B. Williams.
10. Electric Heating (with experiments).
11. The Storage Battery.
12. The Continuous Current Motor (with experiments).
13. The Alternating Current Motor (with exhibit).
14. Electric Railways.
15. The Incandescent Light.

The dates and meeting place for the lectures will be announced later. Admission, which is free, can only be gained by non-transferable tickets which can be had on application to the secretary.

Chronological History of Electricity—Part II.—1800-1820.

BY P. F. MOTTELAY.

R. BERTHOLLET (Claude Louis), very eminent French scientist, who was the first of the leading chemists to openly indorse the antiphlogistic doctrine propounded by Lavoisier (A. D. 1781), and who with Laplace founded the well-known scientific Société d'Arcueil, admits in his "Essai de Statique Chimique" the analogy existing between caloric and the electric fluid. He believes that the latter during the oxidation of metals does not give out much heat, but causes only dilation of bodies which separates their molecules; such is the case when ammonia is decomposed by electricity. He believes that electricity aids metallic oxidation by lessening cohesion.[1]

When Berthollet and Charles passed heavy electrical charges through a platinum wire, they observed that the latter acquired a temperature about equal to that of boiling water, and therefore not sufficient to fuse the wire. If the metal is one easily oxidized, like iron or copper, the separation of the molecules causes them to unite with the oxygen of the air, and it is therefore the oxidation itself which produces the consequent high degree of heat.[2]

A. D. 1804 ——Jacotot (Pierre), professor of astronomy at the Lyceum of Dijon, states, at page 223, vol. i., of his "Elements de Physique Experimentale," that Wlik, teacher of natural philosophy at Stockholm, invented the electrophorus during the year 1762. Jacotot, of course, refers to Johannes Carolus Wilcke (see A. D. 1757) who, during the month of August, 1762, constructed a resinous apparatus to which he gave the name of *perpetual* electrophorus. (Scripta Academiæ Suec., 1762.) Books V., VI. and VII. of the same volume treat respectively of electricity, Galvanism and Magnetism.[3]

A. D. 1804.——Hatchett (Charles), F. R. S. and foreign member of the Paris Academy, communicates through a paper entitled "An Analysis of the Magnetical Pyrites . . ." his curious observations that iron must be combined with a large portion of either carbon, phosphorus or sulphur in order to acquire the property of receiving permanent magnetic virtue. He observes, however, that there is a limit beyond which an excess of either of the above-named substances will render the compound wholly incapable of exhibiting the magnetic energy. The interesting observations of Messrs. Seebeck, Chenevix and Dr. Mat Young on anti-magnetic bodies will be found in vol. xiv., p. 27, of the Eighth "Encyclopædia Britannica."

Three years before, on the 26th of November, 1801, Mr. Hatchett had communicated to the Royal Society an interesting paper on *columbium*, a new metallic substance found in an ore from the State of Massachusetts.[4]

A. D. 1804.——Mr. Dyckhoff publishes in *Nicholson's Journal*, vol. vii., pp. 303 and 305, "Experiments on the activity of a galvanic pile in which thin strata of air are substituted instead of the wet bodies." His description of what has by many been called the first practical dry pile is as follows:

> I constructed a pile with discs of copper and zinc, and little bits of thin green glass about the size of a lentil, three of which I placed triangularly in the intervals that separated the metallic plates. Thus between each pair of metals I had a thin stratum of air instead of a wet substance. A pile of ten pairs tried by the condenser affected the electro-meter as powerfully as a common (voltaic) pile of five pairs.

It was in the year following, 1805, that Wilhelm Behrends, of Frankfort, constructed his dry pile consisting of eighty pairs of discs of copper, zinc and gilt paper.[5]

The investigations of Maréchaux, De Luc, Zamboni and others in the same line will appear in due course.[6]

A. D. 1804——Gay-Lussac (Joseph Louis), one of the most prominent of modern scientists, who was for a time assistant to Berthollet, makes, in Paris, two ascents in a balloon, at heights varying between 12,000 and 23,000 feet, for the purpose of carrying out extensive observations upon terrestrial magnetism. The latter are recorded at length in the *Journal de Physique*, vol. lix., and are alluded to in the articles "Aeronautics" and "Meteorology" of the "Encycl. Brit.," likewise at Biot, A. D. 1803, and in paragraphs 2,961 and 2,962 of Faraday's "Experimental Researches in Electricity," while at page 193, vol. xxi., of the *Phil. Mag.* will be found the account of a very interesting aerial voyage made during January of the same year (1804) by Mr. Sacharof, of the St. Petersburg Academy of Sciences.

In conjunction with Louis Jacques Thénard (alluded to at Fourcroy, A. D. 1801), Gay-Lussac communicates to the *Annales de Chimie* for 1810 (vol. lxxiii., p. 197, etc.) a paper relative to their "preparation of an ammoniacal amalgam through the agency of the voltaic pile" which had been read at the "Institut National" during the month of September, 1809, and which is also alluded to at pages 250, etc., of the *Annales de Chimie*, vol. lxxviii., for 1811. Their united "physico-chemical researches on the voltaic pile . . ." are reviewed at p. 243, etc., of the last named volume and are likewise alluded to at p. 36 of vol. lxxix. for the same year.[7] The largest of the many piles they employed in their several experiments consisted of 600 pairs with a square of 1,800 feet.[8]

At pages 76, etc., of the second volume of the *Annales de Chimie et de Physique* for the month of May, 1816, are to be found the observations of Gay-Lussac upon dry voltaic piles, especially those of Desormes et Hachette, De Luc and Zamboni. He remarks that the last named does not appear to have so constructed his pile as to enable the oscillations of the needle to indicate an exact measure of time,[9] but that the so-called electric clocks of Mr. Ramis, of Munich, and of Mr. Streizig, of Verona, readily pointed the hours, minutes and seconds.[10]

The investigations of Gay-Lussac and Humboldt, relative to the magnetic intensity and dip or inclination, throughout France, Germany, Switzerland and Italy, will be found recorded in the first volume of *Mem. d'Arcueil*, 1807, while at p. 284, vol. x., and at pp. 305–309 of the *Annales de Chimie* are observations of Gay-Lussac and Arago, and at p. 509 of the 4th vol. of Figuier's "Exposition et Histoire, etc.," Paris, 1857, appears an extended account of the special report upon lightning rods, which Gay-Lussac was authorized by the Natural Philosophy Division of the French Academy of Sciences to prepare

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during the year 1823, and the outcome of which appears in the *Comptes Rendus des Séances . . .*, vol. xxxix., p. 1,142.[11]

A. D. 1805.——Mr. Joseph Davis submits to the London Society of Arts an improvement upon the telegraph of Lord George Murray (A. D. 1795), consisting of the addition of a seventh shutter, which, instead of being poised on a horizontol axis, is made to slide up and down in grooves in the centre of the framework; so that it may either range with the six shutters or, if not required at all, may descend into a space provided for it in the roof of the observatory. By this simple device the power of the apparatus is quadrupled, it being made capable of indicating in all 252 changes.

The night signals are given by a colored lamp mounted in the centre of the seventh or sliding shutter and by six white lights fastened to the outside of the frame, to produce, through their display or concealment by slides, the same signals as, under ordinary circumstances, are given by the opening and closing of the shutters.

A. D. 1805.—— Grotthus — Grothuss—(Theodor—more properly Christian Johann Dietrich, Baron Von) makes known his theory of electro-chemical decompositions, through the "Mémoire, etc.," published in 12mo at Rome, and of which an English translation appeared in London during 1806

As Lardner and Fahie have it, Grotthus' theory was the most plausible of the many proposed at this early period of experimental inquiry to explain chemical decomposition by the voltaic apparatus. The above named "Mémoire . . . ." which appeared in the *Phil. Mag.* for 1806, vol xxv., pages 330–334, is analyzed by both of these writers,[12] but it may be briefly stated in the words of Sir David Brewster as follows:

> "Grotthus (*Annales de Chimie* for 1806, vol. lviii., p. 61) regards the pile as an electric magnet with *attracting* and *repelling* poles, the one attracting hydrogen and repelling oxygen, and the other attracting oxygen and repelling hydrogen. The force exerted upon each molecule of the body is supposed to be inversely as its distance from the poles, and a succession of decompositions and recompositions is supposed to exists among the intervening molecules."

In this connection it will be well to add here, by way of contrast, and again in the words of Sir David Brewster, the views held by other experimentalists of the same period. Sir Humphry Davy adopts the idea of attractions at the poles, diminishing to the middle or neutral points, and he thinks a succession of decompositions and recompositions probable. Messrs. Riffault and Chompré regard the negative current as collecting and carrying the acids on to the positive pole, and the positive current as doing the same, with the bases toward the negative pole. Mr. Biot attributes the effects to the opposite electrical states of the decomposing substances in the vicinity of the two poles. Mr. De la Rive considers the portions decomposed to be those contiguous to both poles, the current from the positive pole combining with the hydrogen or the bases which are there present, and leaving the oxygen or acids at liberty, but carrying the substances in union with it across to the negative pole, where it is separated from them, entering the conducting metal, and leaving on its surface the hydrogen or its bases. Dr. Faraday regards the poles as exercising no specific action, but merely as surfaces or doors by which the electricity enters into or passes out of the substance undergoing decomposition. He supposes that "the effects are due to a modification of the electric current and the chemical affinity of the particles through or by which that current is passing, giving them the power of acting more forcibly in one direction than in another, and consequently making them travel by a series of successive decompositions and recompositions in opposite directions, and finally causing their repulsion or exclusion at the boundaries of the body under decomposition in the direction of the current, and that in larger or smaller quantities, according as the current is more or less powerful."

In 1810 Grotthus published his "Uber d. elektricität . . . wassers entwickelt," one of his curious observations being the fact that when water is rapidly frozen in a Leyden jar, the outside coating, not being insulated, receives a weak electrical discharge, the inside being positive and the outside negative, and when the ice is rapidly thawed, the inside is negative and the outside positive.[13]

A.D. 1805.——Alexander Tilloch's *Philosophical Magazine*, vol xxi., p. 279, has a letter addressed by W. Peel to the editor, under date Cambridge, April 23, 1805, relative to the "Production of Muriate of Soda by the Galvanic Decomposition of Water." This is followed by a communication dated Pisa, May 9, 1805, from Dr. Francis G. Pacchiani, Professor of Philosophy at the Pisa University,[14] to Lawrence Pignotti, Historiographer to the King, entitled "Formation of Muriatic Acid by Galvanism," as well as by two letters, one from W. Peel, dated Cambridge, June 4, 1805, on "The Production of Muriates by the Galvanic Decomposition of Water," and the other from Dr. Wm. Henry dated Manchester, July 23, 1805, relative to the above named processes and to the latter's own experiments in the same direction.[15]

A. D. 1806.——On Oct. 16 Mr. Wm. Skrimshire, Jr., addresses from Wisbech a letter to Mr. Cuthbertson on the absorption of electric light by different bodies.

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[1] Delaunay, "Manuel," p. 16.

[2] Essai de Statique," vol. i., pp. 209 and 263. See also "Biographie Générale," vol. v., p. 716; Young's "Lectures," London, 1807, vol. ii., p. 423, and *Nicholson's Journal*, vol. viii., p. 80; Larousse, "Dict. Univ.," vol. ii., p. 617; "Sci. Papers of Roy. Soc.," vol. i., pp. 321-323; Sir H. Davy, "Bakerian Lectures," London, 1840, pp. 41, 94, regarding more particularly Berthollet's elaborate experiments on the decomposition of ammonia by electricity alluded to in *Mem. de l'Acad.*, 1789, p. 324, also Delaunay, "Manuel," pp. 17, 150.

[3] With reference to the *perpetual* electrophorus, see L. S. Jacquet de Malzet "Lettre d'un Abbé de Vienne . . ." Vienna, 1775, translated into German by "A. H." (A. Hildebrand), Wien, 1776; also Cuyper's "Exposé d'une méthode. . . ." La Haye, 1778, and, for other improvements, Marsiglio Landriani, *Scelta d'Opuscoli*, 12mo, xix., 73; J. F. Klinkosch. *Mem. de l'Acad. de Prague*, iii., 218. Consult J. C. Poggendorff, "Biog.-Liter. Hand. . . ." vol. i., p. 1,182, and Larousse, "Dictionnaire Universel," vol. ix., p. 868.

[4] See "Abstracts of the papers . . . of the *Phil. Trans.*," vol. i., p. 155; also the *Phil. Trans.* for 1804, p. 315; *Phil. Mag.*, vol. xxi., pp. 133 and 213; Poggendorff, vol. i., p. 1,031.

[5] De La Rive "Treatise on Electricity," vol. ii., p. 852.

[6] See Young's "Lectures," London, 1807, vol. ii., p. 430, and *Nicholson's Journal*, vol. vii., pp. 303 and 305, Becquerel, Paris, 1851, p. 34; Sturgeon's "Lectures on Galvanism," p. 73; Sturgeon's *Annals of Electricity*, vol. viii., pp. 378, etc.; *Journal de Chimie de Van Mons*, No. xi., p. 190, and also No. xii., p. 300, for Bouvier de Jodoigne's experiments; "Catalogue Scientific Papers of the Royal Society," vol. ii., p. 432; Gilbert, xix., pp. 355-360; and Wilkinson's denial of the effectiveness of Dyckhoff's pile, in *Nicholson's Journal*, vol. viii., p. 1.

[7] Consult, also, Faraday's "Experimental Researches," 1839, vol. i., p. 217 (note), as well as paragraph No. 741 "Researches Physico-chimiques," p. 12, and J. Farrar's "Elem. of Elec. Mag.," 1826, pp. 151-152; while for Gay-Lussac and Thénard's repetition of Sir Humphry Davy's experiments on the decomposition of the alkalies see *Phil. Mag.*, vol. xxxii., p. 88.

[8] Figuier "Exposition et Histoire . . .," 1857, vol. iv., pp. 387 and 433; *Journal des Mines*, vol. xxx., pp. 5-56; Schweigger's *Journal*, vol. ii., pp. 409-423.

[9] Schweigger's *Journal für Chemie*, vol. xv., pp. 113, 130-132.

[10] Schweigger's *Journal*, vol. xiii., p. 379; Ronald's Catalogue for notices of his own as well as of the clocks of Ramis and of Streizig.

[11] Consult, also, "Instruction sur les parat . . ." for Gay-Lussac, Fresnel, Gineau, Lefevre and others, Paris, 1824, and for Gay-Lussac and Pouillet, Paris, 1835. Other reports on lightning rods not hitherto specially mentioned are: J. Langenbucher, 1783; Beyer, 1806-1809; P. Beltrami, 1823; Bourges, at Bordeaux, 1837; Boudin, 1855, and J. Bushee, Amer. Assoc., 1868. The observations of Thénard and Dulong are recorded at paragraphs 609, 612, 636, 637 of Faraday's "Experimental Researches," as well as at vols. xxiii., p. 440; xxiv., pp. 380, 383 and 386 of the *Annales de Chimie*, and those of Thénard, Fourcroy, and Vauquelin will be found in the *Mem. des Soc. Sav. et Lit.*, vol. i., p. 204. See "Royal Society Catalogue of Sc. Papers," vol. ii., pp. 800-807; "Discours de Mr. Becquerel . . ." *Inst. Nat. Acad. des Sciences;" Phil. Mag.*, vols. xx., p. 83; xxi., p. 22); *Sci. Am. Supp.*, p. 11,794; *Edinb. Magazine*, vol. v., p. 471; *Annales de Chimie et Physique* for 1818, vol. viii., pp. 68, 161, 163; the Eighth "Britannica," vol. viii., pp. 532, 539, 573 for Gay-Lussac's additional experiments; the Ninth "Britannica," vol. x., p. 122, etc; also *Report Brit. Asso.*, London, 1838, pp. 7-8, for the magnetic observations of Gay-Lussac and Humboldt on the European Continent, likewise Sir Humphry Davy "Bakerian Lectures," London, 1840, pages 134-137; Humboldt, at A. D. 1799, and Cruikshanks, at A. D. 1800. For a description of the Volta eudiometer invented by Gay-Lussac, see *Ann. de Ch. et Phys.*, vol. iv., p. 188, also Dr. Hare in *Silliman's Journal*, vol. ii., p. 312, and for the "Memoir of Louis Jacques Thénard," by Mr. Flourens, see the "Report of the Smithsonian Institution" for 1862, pages 372-383.

[12] Lardner, "Electricity, Mag. and Meteor.," vol. i., pp. 135-137, or "Popular Lectures," 1851, vol. i., pp. 348, 349; Fahie, "Hist. of Elec. Teleg.," pp. 210, 211.

[13] See Faraday's "Experimental Researches," articles 481, 485, 489, 492, 507, etc.; also, *Phil. Mag.*, vol. xxviii., pp. 35 and 59, and xxiv., p. 183; Joseph Izarn, "Manuel du Galvanisme," pp. 280-284 for M. Riffault and N. M. Chompré; Whewell, "History of the Inductive Sciences," vol. ii., p. 304; Noad, "Manual," pp. 364, 365; William R. Grove, "On Grotthus' Theory. . . ." London, 1845; J. S. C. Schweigger's *Journal*, vols. iii., iv., ix., xxviii. and xxxi.; A. F. Gehlen's *Journal* for 1808; L. W. Gilbert's *Annalen der Physik*, vol. lxvii.; A. N. Scherer's *Allgem. nördliche Annal. d. Chemie*, vol. iv.; *Annales de Chimie*, vol. lxiii.; *Phil. Mag.*, vol. lix., p. 67; J. C. Poggendorff, "Biog. Literarisches, etc.," vol. i., pp. 959, 960; "Royal Society Catalogue of Scientific Papers," vol. iii., pp. 29-31.

[14] Rees' Encyclopedia, "Galvanism," p. 15.

[15] Consult *Phil. Mag.*, vol. xxii., pp. 153, 179, 188; xxiii., p. 257; xxiv., p. 183; xxvii., p. 82; xxviii., p. 306; Sir Humphry Davy's allusion to above, as well as his own earlier experiments related to Dr. Beddoes, Sir James Hall, Mr. Clayfield and others, in "Bakerian Lectures," London, 1840, pp. 2, 3; Sylvester, at A. D. 1806, and Donovan, at A. D. 1812; Lardner's "Lectures on Science and Art," vol. i., p. 350; Faraday's "Experimental Researches," No. 314; J. F. Macaire, *Ann. Ch. et Phys.*, xvii., 1821; Marni "Sulla formazione . . ." G. B. Polcastro "Giorn. Ital. Letter del Dal Rio," x., p. 182, 1805; Cioni and Petrini, *Phil. Mag.*, xxiv., 167, 1806; The Paris Galvanic Society, *Phil. Mag.*, xxiv., p. 172, and *Ann. de Ch.* vol. lvi., 1806; A. B. Hortentz, *Phil. Mag.*, vol. xxiv., p. 91, 1806; Leop. de Buch, *Phil. Mag.*, vol. xxiv, p. 244, 1806; Veau Delaunay, *Phil. Mag.*, xxvii., p. 260, 1807; G. Innocenti, *Nuova Scelta d' Opuscoli*, ii., p. 96, 1807; P. Alemanni, *Phil. Mag.*, vol. xxvii., p. 339, 1807; C. H. Pfaff, *Phil. Mag.*, xxvii., p. 338, and xxix., p. 19; *Ann. de Chim.*, vols. lx., p. 314; lxii., p. 23, 1807-8; Wm. Henry, *Phil Mag.*, vols. xxii., p. 183; xl., p. 337, 1805-1812; F. G. Pacchiani, in *Nuova Scelta d' Opuscoli*, i., p. 277; Brugnatelli, *An. di Chimica*, vol. xxii., pp. 125, 134 and 144; *Edinb. Med. and Surg. Journal*, of July 1st, 1805; *Phil. Mag.*, vol. xxii., p. 179, as well as vol. xxiv., p. 176, for his letter to Fabbroni.

In this letter, which is given in full at pages 221–283 of the fifteenth volume of *Nicholson's Journal*, he says he was led to his experiments by the well known fact that when the electric current is passed through a lump of sugar it makes the latter appear luminous. He tried many calcareous species, chalk, Ketton stone, the phosphate, nitrate, sulphates of lime, etc., etc., and details some of the results obtained, the most interesting being that given by the sulphuret of lime, commonly called Canton's phosphorus, which, he says, is by the electric explosion rendered the most luminous of all the substances tried.

A. D. 1806.——Heidmann (J. A.), physician at Vienna, publishes his "Theorie der Galvanischen Electricität . . . .," or "Theory of Galvanic Electricity Deduced from Actual Experimentation" (London, 1807). These had been preceded by other important electric reviews at Vienna during the years 1799, 1803 and 1804.

As stated by Guyton de Morveau, Heidmann has given us in the above the complete history of galvanic electricity —including the experiments and observations of Aldini, Arnim, Biot, Bockman, Carminati, Cavallo, Davy, Fontana, Fowler, Gilbert, Haldane, Hallé, Hebebrandt, Humboldt, Nicholson, Pepys, Pfaff, Reil, Reinhold, Ritter, Valli, Vassalli-Eandi, etc., etc.—together with the description of the construction and the relation of all parts of the galvanic pile, termed by him a galvanic battery. Heidmann also gives an account of his very interesting experiments with frogs placed in different liquids as well as with the galvanic chain, and reviews all the known phenomena presented by the voltaic pile.[16]

A. D. 1806.——Doctor Joseph Baronio, of Milan, constructs a galvanic pile composed exclusively of vegetable substances. He makes his discs two inches in diameter of beet roots (*bietola rossa*) and of walnut wood (*legno di noce*), the latter having been freed from all its resinous substance by treatment in a solution of vinegar and cream of tartar. Through this pile he produced convulsions in a frog by excitation with a leaf of coclearia (spoon wort or scurvy grass).[17]

A. D. 1806.——Sylvester (Charles), the author of the articles on Galvanism and Voltaism in Rees' "Encyclopedia," announces that he obtains muriatic acid from pure water by passing through it the galvanic current, but Mr. Wollaston asserts this cannot be done unless the current passes through some vegetable or animal substance containing that acid.

His first paper on the subject appeared in *Nicholson's Journal*, 1806, vol. xiv., pp. 94–98; in Gehlen's *Jour. der Chemie*, vol. ii., for 1806, pp. 152, 153, and in Gilbert's *Annalen der Physik*, vol. xxv., 1807, pp. 107–112, 454, 457. The following paper is entitled "Repetition of the Experiment in Which Acids and Alkalies Are Produced in Pure Water by Galvanism (no animal or vegetable matter, nor oxidable metal being present).[18]

A. D. 1806.——Maréchaux (Peter Ludwig), correspondent of the French Galvanic Society at Wesel, is the first to construct an effective dry pile containing paper discs. He makes known through Mr. Riffault[19] that water is not essential to the production of galvanic effects, and his experiments are repeated for the Chemical Society by Mr. Veau Delaunay, as shown in the *Journal de Phjysique*, Messidor, an 14.

This "Maréchausian Pile," or *colonne pendule*, as it was originally denominated, consists of pairs of oven-dried cardboard, pasteboard or blotting paper, and copper discs, all pierced in such manner as to be suspended by three silken cords which hold them fast in position. Sturgeon remarks[20] that, in this dry column, the electro pulsations are, in consequence of the very great number of interrupting papers, less frequent than in either the processes of Volta or in that of Seebeck, notwithstanding which the instrument produces slow pulsatory currents.[21]

Electric Accumulator Traction in Paris.

The Northern Tramway Company, of Paris, is proceeding to make an experiment with accumulator cars in that city on quite a large scale. There will be two lines, one of about five miles in length, and the other about six, starting from points in Paris and running out to the suburbs, over roads with very uneven grades. The steepest inclines are 3.6 per cent., with numerous declines of from 2 to 2½ per cent. The weight of the car is estimated to be about 12 tons. The estimated traction co-efficients and horse powers to be used vary very greatly on different parts of the road, and are of little interest to reprint here without a profile of the road.

There are to be 16 cars in all, which will hold 52 passengers each. There is to be a motor on each axle of about 10 kilowatts when making 1,200 revolutions. The maximum electromotive force to be used is about 200. The speed reduction of the railway of 10 to 1 is made by means of two pairs of gearing, and the guaranteed efficiency between the motor axle and the terminals of the dynamo is 70 per cent.

The battery of accumulators is composed of 108 cells of the Laurent-Cely type, having about 37½ lbs. of active material in the 12 plates of a cell. It is expected that 80.6 miles will be made by each car, the average daily journey of the present horse car in Paris being 62 miles. Each car is to carry 2½ tons of accumulators for a half day's work, thus requiring only two charges a day.

[16] See *Annales de Chimie* vol. lxi., p. 70, and *Phil. Mag.*, vol. xxviii., p. 97.

[17] See *Annales de Chimie*, tome lvii., pp. 64–67, and tome lxii., p. 212; *Phil. Mag.*, vol. xxiii., p. 283; "Nota di Brugnatelli sopra una pila di sostanze vegetabili." Pavia, 1805; *Ann. di Chim. di Brug.*, vol. xxii., p. 304; Volta in *Giorn. Fis.-Med.*, vol. ii., p. 122.

[18] See *Nicholson's Journal*, vol. xv., 1806, pp. 50–52, and xxiii., pp. 258–260; Gehlen's *Journal*, vol. ii., 1806, pp. 155–159. For his other papers see *Nicholson's Journal*, vols. ix., p. 179; x., pp. 106, 107; xix., pp. 156, 157; xxvi., pp. 72–75; Gilbert's *Annalen*, xxiii., pp. 441–447; "Sci. Papers Roy. Soc.," vol. v., pp. 900, 901; Sturgeon's "Scientific Researches," Bury, 1830, p. 153; Sir Humphry Davy's Lecture "On Some Chemical Agencies of Electricity," read Nov. 20, 1806; *Ann. de Chimie*, vols. lx., p. 314, and lxi., pp. 330, 331.

[19] *Annales de Chimie*, tome lvii., for January, 1806, p. 61.

[20] "Researches," pp. 199 and 239.

[21] See W. Sturgeon's *Annals of Electricity*, vols. i., p. 256 (note); viii., pp. 379 and 484; *Phil. Mag.*, vol. xxiv., p. 183; Poggendorff, vol. ii., p. 46; "Roy. Soc. Cat. of Sci. Papers," vol. iv., p. 236; L. W. Gilbert's *Annalen der Physik*, vols x.-xxvii.; vol. xv., p. 98, and vol. xvi., p. 115, giving a description of Maréchaux electro-micrometer (screw and silver leaf), and vol. xxii., containing an account of the observations made by Mr. Paul Erman.

The Liverpool Overhead Electric Railway.*

BY JAMES HENRY GREATHEAD, M. I. C. E.

The question of improved and more rapid means of transit for passengers is occupying attention in many of the great cities at the present time. With the extension of areas covered the question becomes increasingly pressing.

In London it has been under consideration for many years, and during the last session a joint committee of the two Houses of Parliament reported favorably upon a number of proposed underground electric railways of the type of the City & South London Railway, completed and opened for traffic in 1890.

In Paris, Berlin and Vienna similar railways have been promoted and are under discussion; while in New York, a city long since provided with elevated railways and tramways along most of the main thoroughfares, a Rapid Transit Commission has lately reported in favor of an extensive system of underground electric railways, and in other American cities, notwithstanding the rapid development of electrically worked tramways, additional facilities in the shape of over and under ground lines are being considered.

This question, then, is an important one for engineers and the iron industries.

All the proposed underground lines are, since the construction of the City & South London Railway,

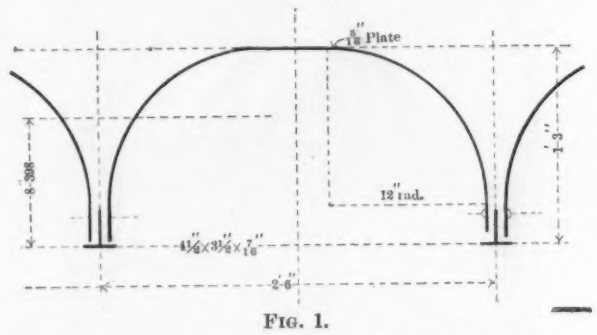


Fig. 1.

proposed to be made of iron, and that material must necessarily enter largely into the construction of any overhead railway.

The particular railway under discussion is composed almost entirely of wrought iron. The line, now approaching completion, traverses the whole length of the famous Liverpool Docks, a distance of about six miles. The extensions north and south, authorized last session, go beyond the docks and away from the river in order to give better access between the residential neighborhood reached by them, the docks, and the heart of the city.

With the exception of a short length where the line passes under the Lancashire & Yorkshire Railway coal sidings, the railway is, as its name indicates, overhead, and for the most part just over the lines of the original Dock Railway, which is upon the surface. The latter railway serves for the distribution of goods by horse traction, and has been used also by passenger omnibuses, with specially constructed wheels to enable them to leave the track when necessary. They will leave the rails altogether upon the completion of the overhead railway, which will afford a means of transit at least three times as rapid, when the Dock Railway will be available exclusively for goods.

The overhead railway consists generally of plate-iron girders supported upon channel-iron columns, and carrying an iron flooring, upon which the permanent way is laid direct, without the usual intervening ballast. The normal spans are 50 feet, but there are some 100 feet, with bowstring girders, and others of special construction for opening and affording a passage to the docks for exceptionally bulky goods, such as marine boilers, etc.; thus there is a tilting bridge near the Sandown Dock, and a swing bridge of novel construction, and worked hydraulically, crossing the entrance to the Stanley Dock. This is the only dock entrance crossed by the railway, the other docks being on the river side of it.

The columns are grouted into cast iron sockets, bedded in and bolted to masses of concrete, forming the foundation. With the exception of some half-dozen spans, the line has been constructed without the use of scaffolding, and with very little interference with the traffic, either of the docks or of the streets. This important end was attained by adopting a construction which admitted of each span and its flooring being put together at one end, and transported as a whole over the already completed portion of the railway.

A depot was established at the north end of the railway, where the flooring was constructed and riveted together and to the main girders. The whole span was then raised by jacks; a steam bogie with wheels running upon the two rails nearest the main girders (and thus having a gauge of 16 feet) was run under the span, which, being lowered upon the trolley, was carried by it at such a level as to clear the main girders to the southern end of the structure. Arrived at this point, the span was slung upon a movable gauntree, and by it deposited upon the columns prepared to receive it. In this manner span after span was added, as many as 10 being placed in a week, representing a length of 500 feet of railway.

The decking is of arched plates (see Fig. 1), finishing to 2 feet 6 inches wide and 15 inches deep, made watertight by asphalt placed in the V channel between the arches. This form of flooring (known as Hobson's arch plate system), first used on this railway, is being extensively used elsewhere. It is for its weight of great strength and stiffness, and is readily made watertight. The flooring is made of ordinary iron plates and tees. The plates are 46 inches wide by 5-16 inches thick, and vary in length from 22 feet to 27 feet. The tees are 4½ inches by 3½ inches by 7-16 inch section, and are of lengths corresponding to the plates. A cross-section is shown in Fig. 1.

In order to ascertain the exact strength of the floor, some actual sections were tested to destruction, and the deflections at each increase of load were carefully tabulated with the following results:

Test.—(*a*) Three sections of floor measuring 7 ft. 6 in. in width.

(*b*) Span, 22 ft., ends resting upon supports.

(*c*) Load distributed over four points corresponding with the positions of the rails.

Test Load.	Deflection at Centre.
30 tons	nil
35 "	¼ inch
40 "	7/16 "
50 "	9/16 "
60 "	3/4 "
70 "	13/16 "
80 "	1 1/16 "
90 "	1 1/8 "
100 "	1 3/16 "
110 "	2 " (limit)

The floor plates ultimately collapsed by the total rupture of the T iron at 160 tons, and with a deflection of 10 inches.

A short description of the construction of the decking at the north end may be of interest. The flat plates are delivered sheared to exact length and width. Six of them at a time are heated in a long oven (to a cherry red heat), whence they are separately hauled out endways into a hydraulic press, which bends them to the required shape. After cooling upon a grid or frame, where they are tightly held to prevent change of form, they are taken to a multiple drilling machine, which drills the requisite rivet holes (about 200) in two operations and in 15 minutes. After the end angle irons, for attachment to the main girders, are added, the decking is completed by riveting mechanically the covered plates to the T irons forming the lower member. These combined operations are performed at the rate of 40 to 45 plates per day.

There are to be 15 stations. They are built upon iron girders and columns, the platforms being about 115 feet in length by 12 feet wide, and are 3 feet above rail level. Access to the platform is gained from the street level by four staircases at the more important stations, and on each platform a waiting shed is provided with pay offices and turnstiles. An extensive carriage shed is erected near the Hornby Docks, with five lines of way running through at the same rail level as the main structure of the railway; and underneath, on the ground floor, is the repairing shop, to be equipped with the necessary tools. The railway is to be worked by electricity, generated at a station, for which 12 of the arches, forming the viaduct which carries the coal sidings of the Lancashire & Yorkshire Railway, have been appropriated, near the Bramley Moore Dock, and about the middle of the line. At this station are three engines, each capable of working up to 400 i. h. p., and each driving a separate Elwell-Parker dynamo. The electricity will be carried north and south along the railway by a steel conductor, placed on porcelain insulators, supported upon cross timbers between the rails of each line.

Hinged collectors of cast iron, sliding upon this conductor, will make the connection between the motors upon the train and the dynamos at the generating station. The motors are not placed (as on the City and South London Railway) upon a separate locomotive, but are carried by the passenger carriages themselves.

A train will consist of two carriages, each to seat 56 passengers, and provided with a motor at one end. The carriages will be so coupled as to give a motor at each end of the train, and the motors will be so connected together as to be controlled from either end by the driver, who will always travel at the front end, changing ends upon arrival at a terminus, and carrying with him a key, without which the motors cannot be operated.

All the carriages will be exactly alike, and will contain compartments for two classes of passengers, with through communication from end to end of the train under the control of the guard. A train loaded with

*A paper read at a meeting of the Iron and Steel Institute, London.

passengers will weigh about 40 tons. The trains will be lighted by electricity, and are fitted with the Westinghouse brake, deriving its compressed air from a reservoir on the train, the reservoir being charged after each journey. This system of working the brakes has been found to answer well on the City and South London Railway. The generating station will contain at first six boilers of the Lancashire type, each 30 feet long by 8 feet diameter, with a working pressure of 120 lbs., and stoked mechanically. The engines are horizontal, compound condensing, by Messrs. John Musgrave & Sons, Bolton. It is intended to commence running with a five-minutes' service of trains, but the generating plant is designed to be capable of working a three-minutes' service, and the journey from end to end of the railway (inclusive of stoppages) is to be performed in half an hour. There are 13 stations upon the dock portion of the line, and a novel feature on the railway will be a system (Timmis') of automatic signals at all the intermediate stations, in place of the ordinary signaling arrangements. These signals will be electrically worked by the trains themselves, and considerable saving in the working expenses will result.

The permanent way, it will also be noticed, is of a novel construction. Longitudinal sleepers, resting directly upon and keyed to the arched decking, support the rails and the electric conductor. As already stated, there is no ballast between the permanent way and the structure, and the working charges in connection with the maintenance and repair of the permanent way should be exceptionally light.

The total cost of the railway, including equipment, will be about £85,000 per mile. Mr. J. W. Willans is the contractor for the works, and the Electric Construction Corporation, Limited (Wolverhampton), is providing the electrical equipment and the carriages. The engineers, Sir Douglas Fox and the author, have been represented on the work by Mr. Francis Fox and Mr. S. B. Cottrell, and Mr. F. Hudleston has had charge of the work (for Mr. Willans), and to him is due the credit for the design of the tilting and swing bridges referred to. It is intended to open the line for traffic very shortly.

The Measurement of Hysteresis and Eddy Current Losses in Transformers.—II.*

BY SYDNEY EVERSHED AND ERNEST B. VIGNOLES.

COMPARISON OF OBSERVED WITH CALCULATED LOSS.

In order to compare this observed loss with that calculated from the **B H** cycle obtained by our ballistic-galvanometer method added to the calculated waste by eddy currents, the transformer was put through the cycle referred to with the following results, care being taken that the maximum induction density was the same as that in Experiment II.

EXPERIMENT III.—B H CYCLE.

Transformer used in Experiment II. wound with $P_1 = 20$ turns; $P_2 = 40$ turns; secondary = 300 turns.

TABLE II.

Rising.		Falling.	
Total mag. force.	Total induction.	Total mag. force.	Total induction.
− 126	930	228.0	43,100
− 75.5	1,460	111.0	42,400
− 25	2,720	+ 10	40,000
+ 30	7,450	− 25	35,800
+ 49.4	15,500	− 55.5	25,900
+ 77.6	29,000	− 56.0	25,400
+ 112.0	39,400	− 63.0	22,400
+ 144.0	39,000	− 90.7	12,500
+ 231.0	42,800	− 87.6	13,350

These results are plotted as a curve in Fig. 71. In order to give the loss per cubic centimetre per cycle, for comparison with other curves, the curve has been plotted from the co-ordinates:

$$\mathbf{H} = \frac{\text{Total magnetizing force}}{\text{length of iron path}};$$

$$\mathbf{B} = \frac{\text{Total induction}}{\text{area of iron}};$$

but these co ordinates have no physical meaning, as the length of the induction path varies nearly 100 per cent.

The falling curve is only taken to see if the difference in area due to time lag amounts to much in this sample. The curve plotted is obtained by folding back the rising curve in the manner described. Note the time lag at the top reading. On "make" the induction is 42,800, while on breaking, although the current has fallen to 228 from 231, the induction is higher, 43,100.

The area of this curve is a measure of the average loss per cubic centimetre in the ring due to hysteresis, when the iron is carried through its cycle in about two seconds, as explained in connection with Fig. 3.

Calculating the work from the area of the curve by the formula—

$$\text{Total work in ring} = \frac{\text{area of curve}}{4\pi} \times \text{volume of ring.}$$

$$= 443{,}000 \text{ ergs per cycle.}$$

Therefore at 100 ~, the loss would be 4.43×10^7 ergs per second, or 4.43 watts.

* Concluded from THE ELECTRICAL WORLD of Oct. 15, 1892.

CALCULATION OF EDDY CURRENT LOSS.

The eddy current loss was calculated from the following formula:

$$W = \frac{\pi (\dot{\mathbf{B}})^2 t}{6 n \rho \log_e \frac{R}{r}}$$

Where $(\dot{\mathbf{B}})$ = effective rate of change of total induction (in volts).

t = thickness of each lamina in ring.

ρ = specific resistance of the iron in ohms.

R = outer radius, r = inner radius } of the ring.

n = number of laminæ.

(A proof of this formula will be found at the end of the present article.)

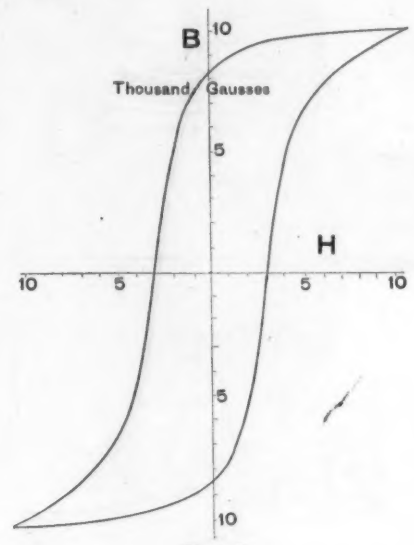


FIG. 7.

Substituting the following values in the above equation, namely:

$$(\dot{\mathbf{B}}) = \frac{4.4 \times \text{total induction} \times \text{frequency}}{10^8} \text{ volts,}$$

$$= \frac{4.4 \times 21{,}300 \times 100}{10^8} \text{ volts.}$$

$$= \frac{9.37}{10^2} \text{ volts,}$$

$t = 0.0414$ centimetres,

$\rho = \frac{13.5}{10^6}$ ohms (average of three determinations of actual iron used),

$R = 4.64$ centimetres, $r = 2.08$ centimetres, $\log. \frac{R}{r} = 0.803$,

$n = 20$,

we find the total energy spent in eddy currents in the core is $W = 0.88$ watts.

As we point out at the end of this article, this value is, for several reasons, slightly too high; but since it is only one-sixth of the total waste, an error of 6 per cent. in the estimation of the eddy current loss will only produce one of 1 per cent. in the total.

Adding these two figures, 4.43 and 0.88 watts, we get the total predicted loss, on the assumption that the work done in overcoming hysteresis at a frequency of 100 ~ is the same as it is found to be by measurement at a frequency of about 0.5 ~.

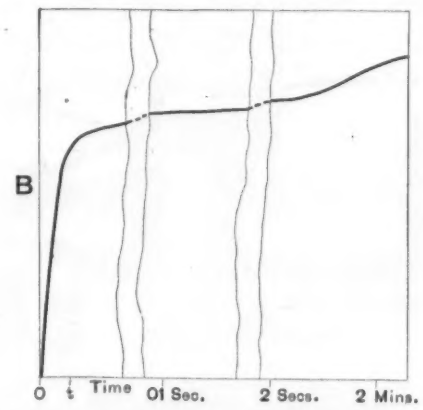


FIG. 8.—CURVE ILLUSTRATING GROWTH OF **B** IN IRON WITH TIME AFTER APPLICATION OF t REPRESENTS A TIME COMPARABLE WITH THE VIBRATION PERIOD OF AN IRON MOLECULE.

We have, then,

Hysteresis loss	= 4.43 watts.
Eddy currents	= 0.88 "
Predicted total	= 5.31 watts.
Measured total by thermometric method	= 5.40 watts.
Difference between observed and predicted loss	= 1.8 per cent.

PRACTICAL CONCLUSIONS.

The result just given will, we venture to hope, finally set at rest the vexed question of magnetic time lag, so far as it affects electrical engineering.

Clearly the difference in the work done in carrying a piece of iron through a complete magnetic cycle in periods even so widely different as 2 seconds and 0.01 second is too small to be detected with certainty by the methods of experiment employed—it cannot possibly be greater than 4 or 5 per cent., and is probably under 2 per cent.; in other words, in designing a transformer or an alternator the hysteresis can be determined with abundant accuracy from the cyclic curve, of a sample of the iron to be used, taken by a ballistic galvanometer method. If the meter used in our investigations is adopted, and the rising curve of induction only is used, no correction for time lag is required; if, however, a method of testing is employed involving a necessarily slow cyclic period—of the order minutes rather than seconds—an indeterminate error is introduced which may amount to 20 per cent. or more of the estimated loss.

Another important conclusion should be drawn from our results by engineers, and that is that every one of the published tables of hysteresis losses for "charcoal iron of good quality" is a trap for the unwary. Prof. Ewing was, we believe, the first to publish such a table, and his figures have been almost universally copied and adopted. Unfortunately, no material is more variable in its qualities than the so-called "charcoal iron," and Prof. Ewing's results can only be held to be true for the particular samples which he used.

Mr. Alexander Siemens, Mr. Swinburne, and, since writing this article, M. Dobrowolsky, have all published tests showing far higher hysteresis losses in iron than those given by Prof. Ewing; for example, Mr. Siemens found the waste some 70 or 80 per cent. in excess, and M. Dobrowolsky confirms this result. We have ourselves tested samples of charcoal iron which gave results about 20 or 30 per cent. above those of Prof. Ewing's table, but the transformer core used in the present experiments has a hysteresis waste about 90 per cent. in excess of Prof. Ewing's iron; and it must be distinctly understood that this iron and the sample just referred to were made at the same mills, sold as the same quality, and have nearly the same permeability. So that unless a manufacturer of alternators and transformers is prepared to leave the temperature of the cores to chance, letting them vary as much as 100 per cent., he must test every batch of iron sheet or wire received from the mills. The same remarks apply, but of course with less force, to the armature cores of direct current dynamos.

The introduction of some simple and direct method of testing samples of iron for hysteresis would go far toward securing more attention to quality on the part of the iron manufacturers, with the natural result of greater uniformity, and we shall no doubt see the day when it will be as much a matter of course to buy and sell iron on a specification of "not more than 6,000 ergs per cc. per cycle," as it now is to specify for copper of 98 per cent. conductivity. Prof. Ewing is already in the field with a magnetic curve tracer, and his ingenious device is probably the "Puffing Billy" of magnetic testing; the "Rocket" has yet to be built.

So much for practical results. We may just emphasize the theoretical point of interest which is very clearly indicater by the experiments described. When we trace a cyclic curve very slowly—taking, say, a minute or so to complete one cycle, the curve has a certain area—to fix our ideas, say an area of 100. When we use the method already described in which the iron completes its cycle in about two seconds, we find the area has increased to about 120, but by decreasing the time to $\frac{1}{100}$ second, we do not appreciably add to the area; it is certainly not increased to more than 125.

Evidently, then, the creeping up of the induction is a slow process, for the value of the induction is practically the same after two seconds as it is after 0.1 second; but give the iron a minute or so and the magnetic chains slowly break up and the induction as slowly increases. The question naturally presents itself, would the value of the induction one-millionth of a second after the application of the force differ from that after one-hundredth of a second? The experiments hardly do more than suggest an answer, but it seems unlikely that any appreciable difference would be found until the interval of time approached the value of molecular vibration periods. In Fig. 8 we give a curve which is a rough illustration of this view of the relation between the value of **B** and time after application of **H**; the curve has, of curve, no pretense to scale or proportion.

In this connection "molecular vibration periods" must be understood to mean periods of the magnetic molecule, or Ewing particle, which is not necessarily identical with the chemical or physical molecule; and by exploring the hypothetical curve in Fig. 8 toward zero we might arrive at some quantitative idea of the structure of magnetic substances.

APPENDIX.

The formula used in the preceding article for the calculation of eddy current losses may be obtained as follows:

Consider one stamping of the core, of inner and outer radius r and R and t cms. thick; let the axis of figure be the axis of x; any radial line bisecting the section of iron the axis of y.

Then, if M be the magnetizing force due to the exciting current, the induction *density* at any radius y is

$$\beta = \frac{\mu M}{2\pi y},$$

and the E. M. F. in an element dy, dx, $y\,d\theta$ is

$$E = \dot{\beta} \times \text{area} = \frac{\mu \dot{M}}{2\pi y} x\,dy.$$

The resistance of the element is $\frac{\rho\,dy}{y\,dx\,d\theta}$, so that the power spent in it

$$dW = \frac{\mu^2 \dot{M}^2 x^2}{4\pi^2 \rho y} dy\,dx\,d\theta,$$

and the power spent in the whole stamping is

$$W = \int_0^{2\pi} \int_{-\frac{t}{2}}^{+\frac{t}{2}} \int_r^R \frac{\mu^2 M^2 x^2}{4\pi^2 \rho y}\, dy\, dx\, d\theta$$

$$= \frac{\mu^2 M^2 t^3}{24\pi\rho} \log_e \frac{R}{r} \qquad (1)$$

But actually not M, but the total induction ($\mathfrak{B}$) was known. Now,

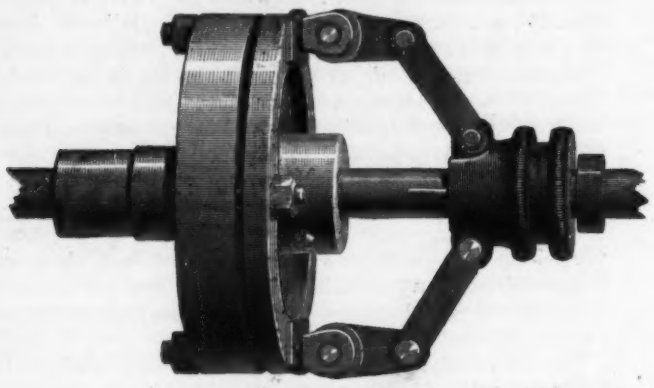
$$(\mathfrak{B}) = \int_r^R n\, t\, \beta\, dy = \int_r^R \frac{n\, t\, \mu\, M}{2\pi y}\, dy =$$

$$\frac{n\, t\, \mu\, M}{2\pi} \log_e \frac{R}{r} \qquad \text{(ii.)}$$

where n is the number of stampings in the core, combining I. and II. we find for the power in the whole core

$$W = \frac{\pi\, t\, (\mathfrak{B})^2}{6\, \rho\, n \log_e \frac{R}{r}} \qquad \text{(iii.)}$$

the formula has been used in the text.



FRICTION CLUTCH.

Several assumptions have been made in arriving at this result.

First that $\beta = \mu\, \mathfrak{H}$,

that is to say, that the induction density is proportional to the magnetizing force; we know that it is not, but the density is so low that no appreciable error is introduced; we are dealing with total induction only, and a different distribution of that total in the section hardly affects the results.

Secondly, we assume the magnetizing force to be the same at the centre of a lamina as it is at the outside. A formula recently given by Prof. J. J. Thomson shows that it is really about 2 per cent. less; but here again the fact that the induction is a little displaced toward the outside of the iron diminishes the power spent by an entirely negligible amount.

Thirdly, we assume the conductivity of the lamina at right angles to its plane to be infinite, and this also tends to make the formula give too high a result, the error being of the order two per cent. in this case.

Now, as an error of six per cent. in the estimation of the eddy current loss only leads to an error of one per cent. in the estimated value for the waste due to hysteresis and eddy currents together, it is clear that all these assumptions are justified. We must remember that the result given by the formula cannot possibly be too low, but may be two per cent. too high. To the non-mathematical mind the fact that the calculated differs from the measured loss by less than two per cent. will be the most satisfactory proof of the accuracy of the formula.

The American Twist Drill Company's Friction Clutch.

The accompanying cut represents a friction clutch patented in the United States, Canada and Europe, and manufactured by the American Twist Drill Company, of Laconia, N. H. These clutches are made in sizes from one inch to four feet in diameter and from 1 h. p. to 2,000 h. p. They may be run as high as 2,000 revolutions per minute. All sizes of cut-off couplings or friction pulleys are made and placed on shafting by this company, which also furnishes casting drawings with shop-right licenses for parties to make, or have made, their own clutches, no special tools being required in their construction. One of these clutches attached to a Hoe press driven by a 50-h. p. electric motor is in the Boston *Globe* press rooms. Any desired number of revolutions from slow speed to high speed is given by simply moving the shipper handle so as to give the clutch more or less frictional contact. It is as powerful and durable as a bolted flange coupling and has been adopted by some of the largest manufactories and electric light and power stations in New England.

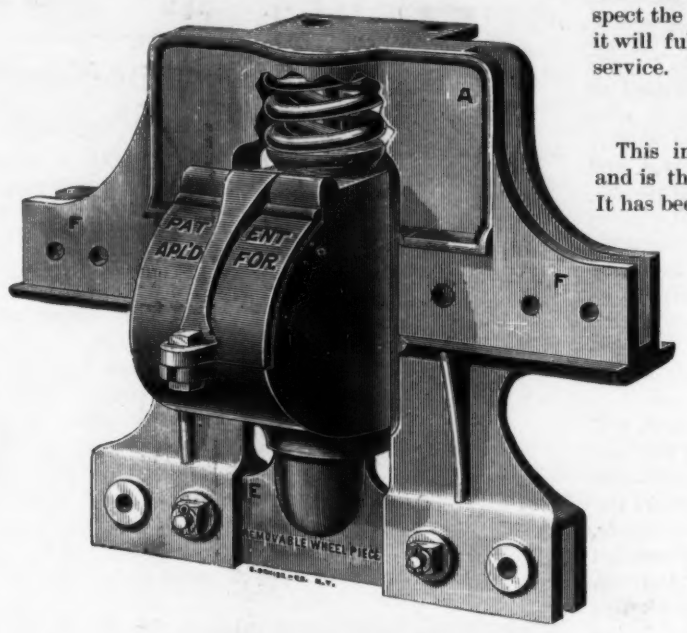
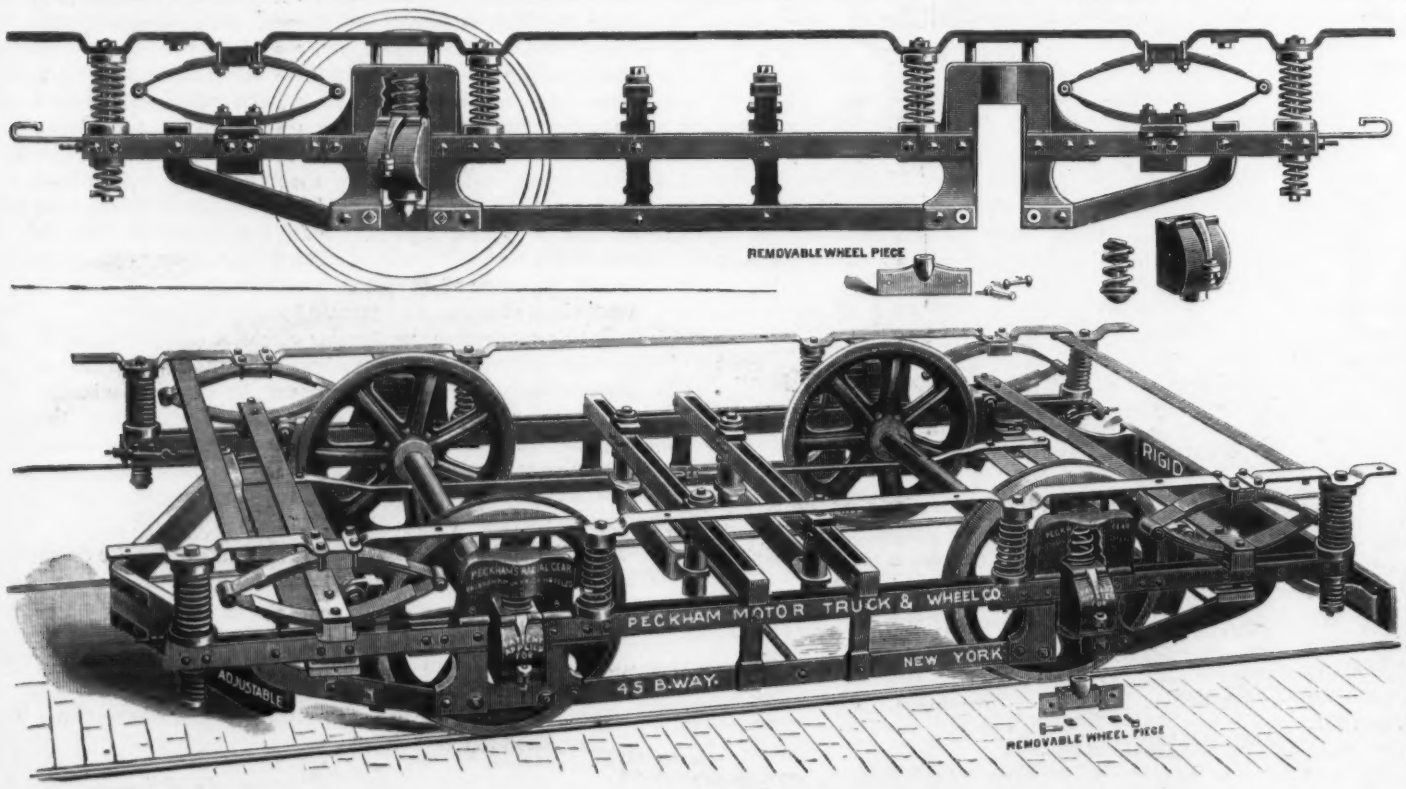


FIG. 1.—THE NEW PECKHAM TRUCK.

The Peckham Radial Geared Cantilever Extension Truck.

A new truck, the invention of Mr. Edgar Peckham, of the Peckham Motor Truck and Wheel Company, of Kingston, N. Y., is shown in the accompanying illustrations. It embodies the practical experience of many years and is adapted for all conditions of electric street car service. Although modeled somewhat after the type of the non-oscillating truck heretofore manufactured by this company, it has a number of decidedly new features. The cantilever principle of supporting the ends of the frame is still retained, but the shape of the side bars is changed, and in place of the bolts the parts are firmly connected with rivets upset while hot so as to prevent the loosening of the parts and the dropping of bolts. The principle of the radial motor hanger is retained, but elliptical springs have been substituted for the spiral springs employed over the main bolster, while a graduated double spring is employed at the ends to prevent tetering. The radial box formerly used is also retained with a few minor changes and the double graduated spring is placed over the journal box to receive shocks, which lessens the wear on the truck very materially. Considerable attention has been given to the design of the journal box, and the radial principle employed relieves the draft very much on curves and permits the easy operation of electrical cars of from 26 to 30 feet in length.

Fig. 3 gives a perspective view of the cantilever extension truck No. 5 A, while Fig. 2 shows the side frame of the same truck. In Fig. 1 is seen the radial gear more in detail. The truck shown in these illustrations is especially adapted to the Thomson-Houston W. P. equipment, but can be modified to suit any type of motor. It will be noticed that there is no obstruction over the motor, so it can be easily reached for inspection without the removal of any part, and the method of hanging insures the proper adjustment of gears under all conditions. This truck has seen considerable active service already, and fulfills in every respect the expectations of the inventor. It is thought that it will fully meet the requirements of actual street car service.

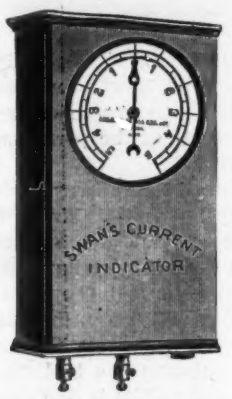


FIGS. 2 AND 3.—THE NEW PECKHAM TRUCK.

The Swan Current Indicator.

This indicator is intended for use on arc light circuits, and is the invention of Mr. F. A. Swan, of Boston, Mass. It has been in constant and satisfactory use since its first introduction. In construction it is simple, durable and reliable. A solenoid placed vertically has a soft iron cylindrical core, capable of free vertical motion to respond to the varying influence of the current passing through the coil. To the top end of the core is connected a multiplying arrangement whereby the movement of the core is magnified so that a variation of one-half ampère will move a pointer or hand about six inches to either side of the zero point. The long movement of the hand and the large white dial make it possible for the working of any circuit in which the indicator is included to be easily observed

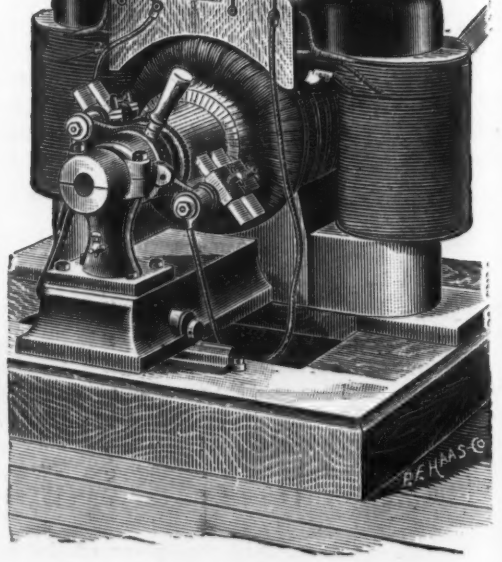
At the lower end of the armature is a piston which works in a dash-pot to prevent the too rapid movement of the pointer or hand. The Boston (Mass.) Electric Light Company has over fifty of these indicators in use on its circuits. The indicator is handled by Messrs. Swan & Lane, 191 Summer street, Boston.



SWAN INDICATOR.

New Akron Dynamo.

The accompanying cut represents the latest improved dynamo of the Akron Manufacturing Company. The essential points claimed are simplicity of mechanical construction and design, high efficiency and slow speed. The large open ring armature admits of a constant current of air through it while in motion. The liability to short circuit in the armature coils is greatly diminished, if not entirely prevented. The efficiency of this dynamo is claimed to be very high, and the workmanship and style of finish throughout is excellent Wherever it has been in operation it has given universal satisfaction, and it has generally



THE AKRON DYNAMO.

been given rank among the highest grade of machines now manufactured.

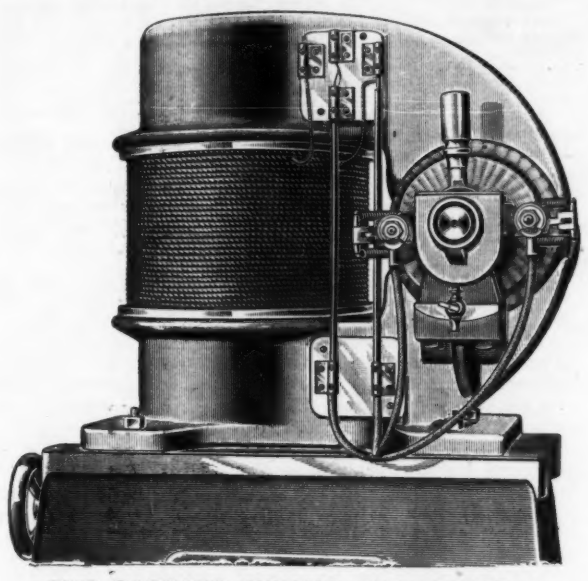
The Akron Electrical Manufacturing Works are crowded to their utmost capacity, and an enlargement of the plant will soon be made to supply the demand for machines.

The Packard Dynamo and Motor.

The Packard Electric Company, of Warren, O., has brought out a very interesting type of dynamo and motor, which may be seen in the accompanying illustration.

The field is built up of wrought iron bars held in place and shaped by a coating of soft cast iron. The wrought and cast iron unite and form one solid mass, and we are thus enabled to secure a very strong magnetic field by the expenditure of a very few watts of electrical energy. There is but one field coil, wound upon a movable spool, and but one joint in the magnetic circle of the machine. The construction is such that the removal and replacement of the field coil is extremly simple. This is a very important item, as every part is built to a gauge, and by substituting another field coil and armature the voltage of the machine can be changed to 110, 220 or 500 volts in a very few minutes.

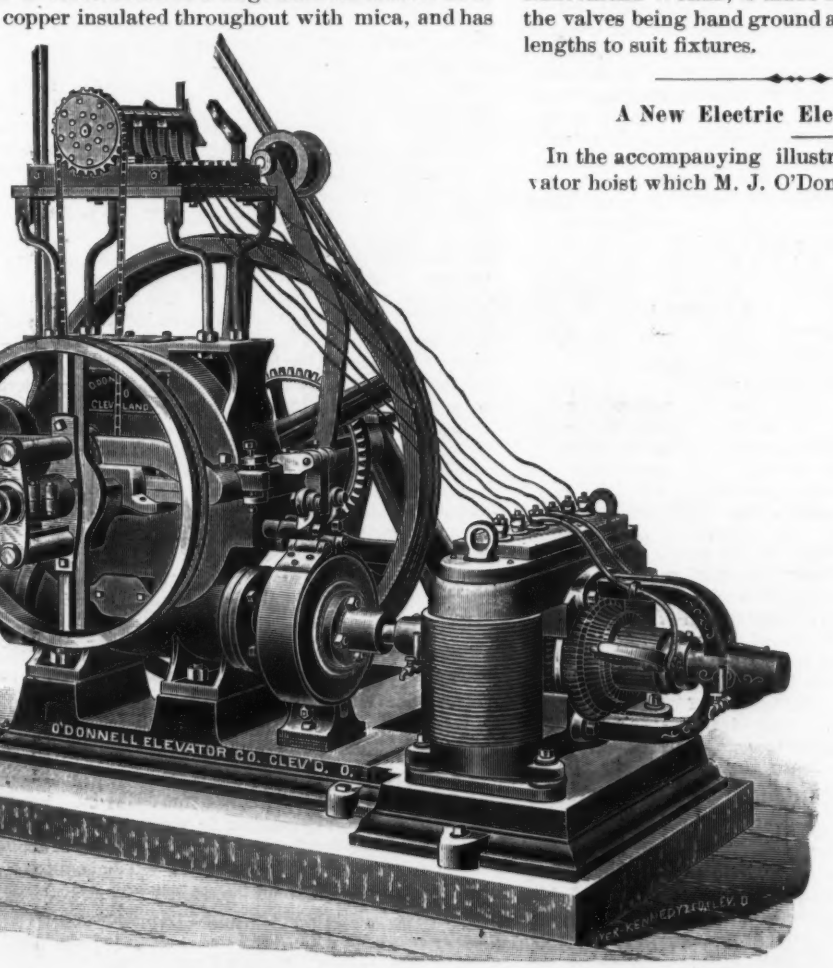
The machine is mounted on a hollow cast iron base which is fitted with a door and designed to be used as a closet for the reception of tools, etc., and is also provided



THE PACKARD DYNAMO AND MOTOR.

with a belt tightener. It is insulated from this base by hard wood.

The armature is of the drum type and is built up of thin discs securely fastened to a shaft made of the best grade of machinery steel of greatest diameter in its central part. The winding is a modification of the Siemens method. The commutator is constructed of a large number of sections of pure, hard copper insulated throughout with mica, and has



THE O'DONNELL ELEVATOR.

ample width of face to secure the best results, and to reduce the wear to a minimum.

A strong point in favor of these machines is freedom from sparking at the commutator. The brushes having been once set at the non-sparking point, require no changing under extreme changes in load.

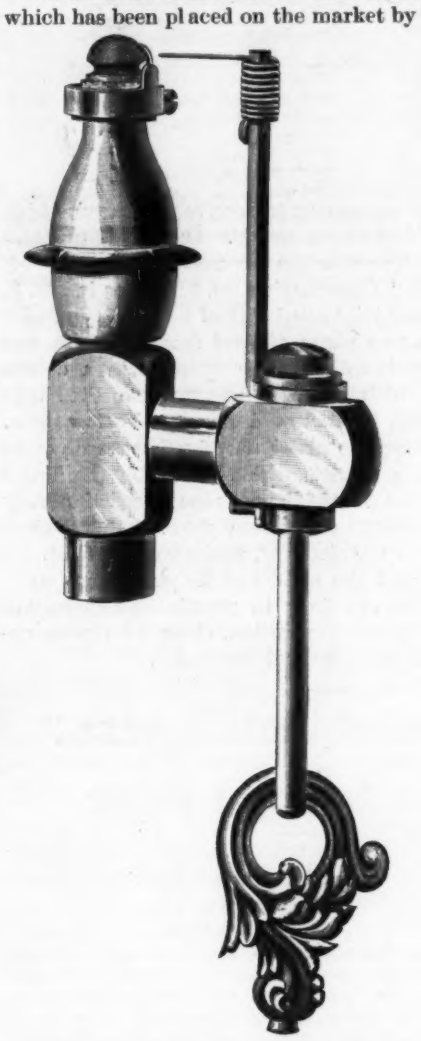
Self-oiling boxes are used on all the motors and dynamos. They are provided with interchangeable bearing sleeves of hard composition turned true to gauge.

The Packard motor and dynamo are self-contained and self-regulating; they are of superior mechanical construction, which insures durability, and their efficiency is claimed to be remarkably high.

Mr. Chas. E. Chapin, 136 Liberty street, is the New York agent of the Packard Electric Company.

Iona Hand Lighting Burner.

We illustrate herewith the Iona hand lighting burner, which has been placed on the market by the Redding Elec-



IONA HAND LIGHTING BURNER.

tric Company, 41 Federal street, Boston, Mass. As will be readily seen from the cut, it is entirely new in design and is very simple. There are no cams or complicated springs to get out of order, and, being operated only by the key, it is absolutely safe from leaking gas. This burner, like the Iona safety pendant mentioned in a recent issue of THE ELECTRICAL WORLD, is made in the most careful manner, the valves being hand ground and the stems made in various lengths to suit fixtures.

A New Electric Elevator in Cleveland.

In the accompanying illustration is seen an electric elevator hoist which M. J. O'Donnell & Co., of Cleveland, O., have recently constructed and placed in operation in that city. It consists of a heavy cast iron bed plate firmly bolted to a stone foundation, to which is bolted the motor as well as the housing that contains the worm and gear and the bearings for the worm-gear shaft. On the gear shaft, which projects through the casing, is a sheave which is turned with a double V groove, which prevents the hoisting cables from slipping. One end of the cable is fastened to the counterbalance weight and the other to the platform toggle. The brake is operated by a cam on the shifter sheave, and attached to this sheave shaft is a sprocket wheel which revolves the arm one-third of a revolution to make the full electric contact on the switch. The motor part of this elevator is designed and manufactured by the Keystone Electric Company, of Erie, Pa., and experience has proved that it will stand almost any amount of il usage.

The Philadelphia Trolley.

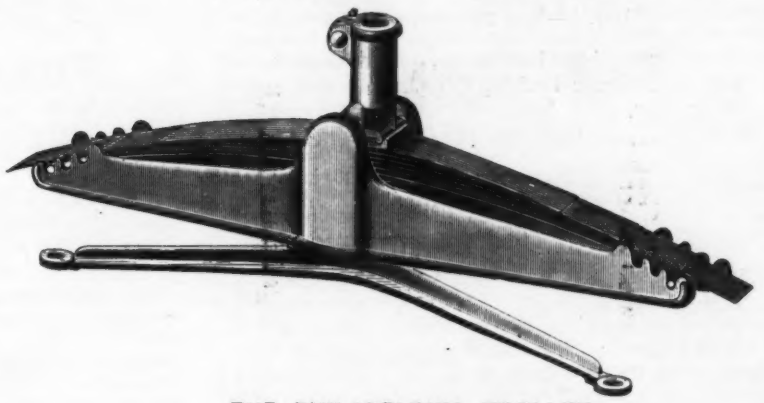
The Philadelphia trolley has been designed to meet the requirements of the electric railway superintendent and engineer. It is exceedingly simple, being made up only of nine parts. It can be dismantled in seven seconds, and assembled in twenty-two seconds, all without a wrench. There is no nut, bolt, screw or washer in its construction, and no chains, coil springs, or similar parts to rust or be broken with ice or snow. No oil or grease is required.

This trolley embodies substantial mechanical design with lightness and durability. All the parts are interlocking and interchangeable, which results in minimum cost of maintenance and repairs. It is pivoted and free to turn, besides having a side motion. The design of the cam against the leaf spring gives it equal tension against the trolley wire from vertical to horizontal positions, and the degree of tension may be adjusted through a wide range.

The Philadelphia trolley is manufactured by the Technic Electrical Works, Provident Building, Philadelphia.

The Stirling Water-Tube Safety Boiler.

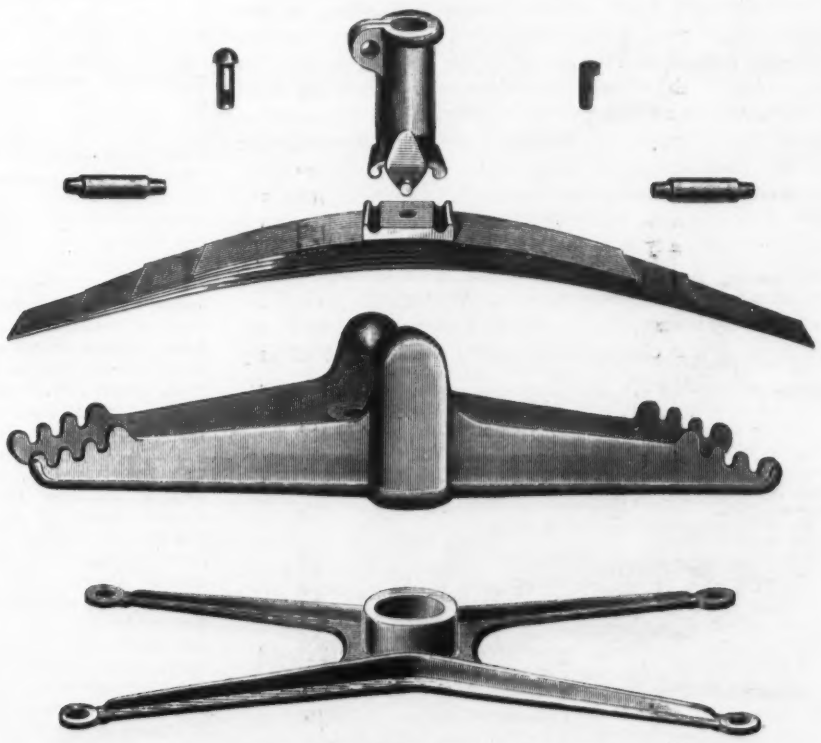
The Stirling water-tube boiler possesses so many excellent features, is such a radical departure in its construction from other boilers of its type, and has met with such a large and steadily increasing sale since its introduction,



THE PHILADELPHIA TROLLEY.

that the following description, although brief, must prove interesting to those who are looking for steam boilers of this class. The boiler consists of four drums 36 inches in diameter, varying in length according to the horse power required. These drums are connected by a large number of tubes 3½ inches in diameter and one-eighth of an inch thick. The drums are made of the best flange steel, with a tensile strength of from 55,000 to 60,000 pounds to the square inch. The tubes are made of the best mild steel, and each tube is tested to a pressure of 750 pounds to the square inch.

The boiler is supported on wrought iron columns and girders and is supported entirely independent of the brickwork. It is made of the very best material throughout,



THE PHILADELPHIA TROLLEY.

and among the many excellent features claimed for it are the following: It is absolutely safe and cannot be exploded under any circumstances; there are no hand hole plates to leak, no packed joints, and no fire contact with riveted joints; the heating surfaces are thin and always clean, and are so distributed as to receive the full benefit from the hot gases from the time they leave the grate until they enter the stack. Each tube is expanded directly into the circulating drums, and furnishes its own outlet, giving 100 per

cent. of outlet as compared with 10 or 15 per cent. of outlet in some other types of boilers. This insures perfect circulation and dry steam and repeated tests of the boiler have shown that even while the boiler was being forced 75 per cent. above its rated capacity the steam contained less than one-half of one per cent. of moisture, and the temperature of the gases where they entered the stack was only 350 degrees. In a brief article like this it is impossible to describe all the good points of the boiler, but the company has issued a neat catalogue, which contains a description of the boiler, a list of customers and many testimonials which they will be pleased to furnish all interested parties, and which can be obtained either of the Stirling Company, Pullman Building, Chicago, or of J. Bradford Sargent, 620 Atlantic avenue, Boston, Mass., the company's Eastern agent.

That the boiler is giving excellent satisfaction there can be no doubt, for there have been a very large number of them sold during the last three years, and an especially large sale has been made during the last six months. A large number of second orders have been taken, some of them for 2,000 h. p., and the Armour Packing Company, of Kansas City, has 5,000 h. p. of these boilers in use. The following is the list of sales made from July 15 to Aug. 20, 1892.

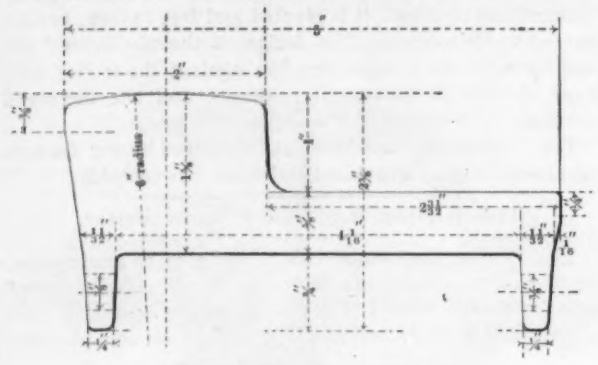


Fig. 1.—The Price Rail.

Clark & Windsor, Joliet, Ill.	200 h. p.
Grand Rapids (Mich.) Gas Co.	100 h. p.
Edison Electric Ill. Co., Altoona, Pa.	200 h. p.
Taplin, Rice & Co., Akron, O.	132 h. p.
Windsor Hotel, Akron, O.	50 h. p.
American Water-Works, Braddock, Pa	250 h. p.
Goebel Brewing Co., Detroit, Mich.	250 h. p.
W. A. Woods' Harvesting Co., St. Paul, Minn.	400 h. p.
" " " second order	150 h. p.
United Salt Co., Cleveland, O.	200 h. p.
Indianapolis Light and Power Co., Ind	1,500 h. p.
Land and Imp. Co., W. Superior, Wis.	100 h. p.
" " " second order	70 h. p.
Montgomery Iron Co., Port Kennedy, Pa.	400 h. p.
Simpson & Watkins, Scranton, Pa.	450 h. p.
Mobile (Ala.) Electric Light and Power Co.	350 h. p.
Sprang Steel Co., Pittsburgh, Pa.	500 h. p.
Armour Packing Co., Chicago, third order	700 h. p.
" " " " fourth order	1,050 h. p.
" " " " fifth order	4 0 h. p.
Charles Heap, Williamstown, Mass.	300 h. p.

Among the large contracts previously closed are the following:

Carnegie, Phipps & Co., Pittsburgh, Pa	1,250 h. p.
San Francisco & San Mateo Street Railway Company	1,750 h. p.
Pacific Rolling Mills, San Francisco	1,500 h. p.
Braddock Wire Company, Braddock, Pa.	600 h. p.
Cincinnati Water Works, Cincinnati, O.	1,200 h. p.
Cold Storage Company, Chicago, Ill.	1,800 h. p.
Minneapolis Street Railway Co., Minn., second order	2,000 h. p.
Toledo Water Works, Toledo, O.	1,500 h. p.
Armour Packing Company, Kansas City	1,000 h. p.
" " " " second order	2,000 h. p.

The Price Solid Rail.

The new rail which the Price Railway Applicance Company, 125 South Fifth avenue, Philadelphia, Pa., is now manufacturing and which is shown in Fig. 1, resembles the "old side bearing rail" in devoting the body of its metal to the surface of the wheels using the track. It differs from it, however, by avoiding vertical spikes through the wagon tread into the supporting wooden sleeper, the fastenings for this rail passing through a thin flange which projects downward from the body on each side. Whatever the substructure that supports the rail it will be seen that its shape makes it extremely economical. In the common form of girder rail a large percentage of the rail is devoted simply to upholding the wearing surface. With the Price rail the substructure is capable of carrying a second rail, while the life of the first is claimed to be nearly double that of any other rail of approximately the same weight. A support o this rail four inches wide and 30 feet in length prevents for this section the leverage and overhang which in girder rails necessitates constant work in the maintenance of the track.

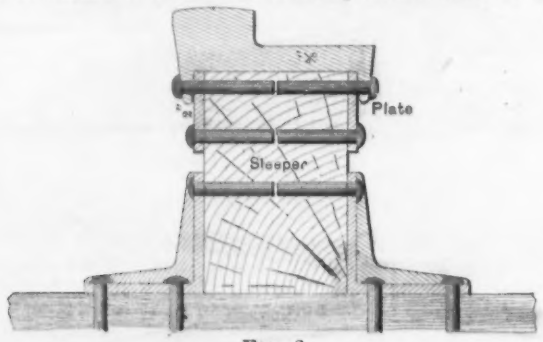


Fig. 2.

The Price rail is placed upon a wooden longitudinal or sleeper faced at each upper edge with thin steel running the length of the sleeper and thus protecting its sides, while the rail covers the top. The wood is thus protected from water, and there are no vertical spikes to carry moisture to the heart of the timber. Where a chair is used to fasten the sleeper down upon the cross tie no contact is permitted between the top of the chair and the edge of the plate or channel, thus avoiding the jar upon the tie.

Fig. 2 gives a clear idea of "Construction No. 5;" as the paving at its upper surface is level upon each side with the surface of the rail at that point, it will be seen that nothing prevents a neat fit of the paving to the rail and its substructure, without any cavity to receive the gravel, which washes out from between the stones. The smoothness and elasticity of such a construction are unsurpassed.

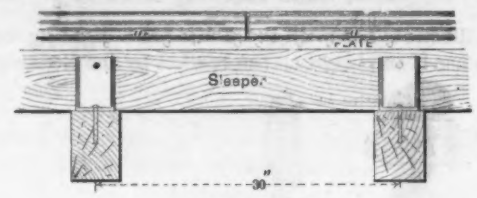


Fig. 3.

A side view of "Construction No. 5" is seen in Fig. 3, the plate and sleeper joint consisting of a wooden cylinder embraced between two plates of steel from three to five inches in depth firmly spiked to the cylinder in a double row of spikes, of which the upper ones traverse the flange of the rail without contact with any metal below them. The middle of these two plates may for that reason come immediately over a crosstie, which is probably the better way of laying, as the ends of the rails are placed absolutely at the one level without concussion from metal contact with the bottom of the plate; or, as shown in the cut, the ends of the rail and the middle of the plates may come midway between the two ties. In practice the chairs will not be so high as in the illustration, since no reason appears to justify the use of superfluous metal.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

New York, Oct. 15, 1892.

New York Financial Market.—Commercial agencies agree that there is a pronounced improvement in general trade conditions. The South is recovering from its long period of depression. Northern and Western cities report a good business. Clearings at seven cities for five days show a decrease of 6 3 per cent. The failures this week were 189, against 227 in the corresponding week last year. Receipts of grain at commercial points are much heavier. Stocks of iron show a decrease of 85,234 tons for September, while the productive capacity increased 32,500 tons per month. This shows an actual increase in consumption of 127,734 tons. There has been an advance of 25 cents at St. Louis and Chicago. The price of silver has advanced in London. The dissolution of the Western Traffic Association did not affect the security market, as it came at a time when the roads are full of business, and there was no temptation to reduce rates to secure tonnage. There is a fair demand for time money at 5 per cent. for 30 days, and 6 per cent. for longer periods. Money is active at Southern and Western centres, ranging from three per cent. in Cincinnati to eight per cent. at Galveston. Rates are well maintained all over the country. Exchange on New York is at a discount in most cities of the North west. The world of Wall street practically suspended operations during the fore part of the week, owing to the Columbus celebration. There was a general closing out last Saturday by holders who foresaw an indifferent market and did not wish to carry over their stock. Notwithstanding, values were well maintained and closed the week slightly higher than the opening, with notable advances in some instances. Owing to the fact that the Exchange takes a holiday on Friday and Saturday of next week, business will more or less be broken up; in consequence we do not anticipate any pronounced movement. However, at the present time, the tendency is upward, and there are many good authorities in the street who believe we are on the eve of a bull market.

ELECTRICAL STOCKS.

In general there has been afloat this week more than the usual number of wild and baseless rumors. A few of the choicest might be designated as follows: Absorption of Postal Telegraph by Western Union; consolidation of Westinghouse and General Electric; ruptures between Thomas A. Edison and General Electric, etc., etc. These are treated fully elsewhere. The Street was also entertained with a controversy between the friends of Westinghouse and General Electric as to the effect of the recent incandescent lamp decision, as well as the new lamp invention promised by Mr. George Westinghouse, Jr., to be shortly placed on the market. Last week we gave Mr. Westinghouse's version; this week we publish the first public statement made by officers of General Electric regarding the same points. Values with hardly an exception scored an advance, which in one or two instances were pronounced. The bond market, with the exception of transaction of Edison Electric Illuminating, was inactive. This was caused partially by the satiated condition of investors and partially by tighter money. There are many people in Wall street, and many who do business there, who are of the opinion that Mr. Cleveland will be elected. In the event of such a contingency they consider that industrial stocks, especially those of the trust order, will suffer. As the day of the election approaches they are growing more and more conservative. North American gained fully a point on small buying orders. These could not be traced, but from their nature are believed to have come from investors. Commercial Cable received no sale but was very strong at 169 asked. If history repeats itself insiders will come into the market in the course of the next week or two, and put the stock up a couple of points. Westinghouse, notwithstanding unofficial statements concerning its liability because of its use of Edison's patents, held its own. There was no pressure of stock for sale, and the only transaction was a small lot of assenting certificates which sold at 77¼, an advance of two points over the lowest quotation of last week. American Telegraph & Cable maintained its pace at 86 to 87.

Edison Electric Illuminating of New York.—This stock was quite active over the same range of values which ruled last week. It opened at 103 and closed strong at 106¼. From the nature of the buying we should judge it is largely for investment; $41,000 worth of its first mortgage 5 per cent. bonds sold at 106 to 106¾.

General Electric.—This stock was beset by all sorts of rumors, both of the bull and bear order. One faction worked industriously to convince the Street that the company was on the verge of dissolution. Another, that it would eventually acquire untold wealth through the incandescent lamp decision by putting the screws on the Westinghouse and other alleged infringers of its patent. If these were calculated to affect the stock they fell wide of the mark. Its course was about the same as during previous weeks; starting in at 118, and reaching 119 yesterday. It is believed that there is but little short interest in this stock, and from present indications there is no one in the Street who thinks poorly enough of it to sell it short. There was an advance of 5 per cent. in debenture bonds, the highest sales being 106¼. The company has declared the twelfth quarterly dividend of 2 per cent. on all the stock of the company, due and payable Nov. 1, 1892, to holders of record Oct. 20.

Western Union.—The annual meeting of this company was held on Wednesday. The result will be found under this head. It opened at 96⅛, sold steadily up to Thursday afternoon, when it advanced a point. Yesterday and to-day heavy buying raised it to 99⅞, and it closed strong at 100⅛ asked. Three weeks ago we published an abstract of this company's report for the year ending June 30. Owing to incomplete returns for the last quarter it was partly estimated. These returns are now all in, and we give it in full, following:

	1892.	1891.	1890.	1889.
Gross	$23,706,404	$23,034,325	$22,387,028	$20,783,194
Op. ex	16,307,857	16,428,741	15,074,303	14,565,152
Net	$7,398.547	$6,605,584	$7,312,725	$6,218,041
Int. and S. F.	960,523	931,219	915,135	835,655
Balance	$6,468,024	$5.674.365	$6,397,590	$5,382,386
Dividends	4,309,638	4,309,607	4,956,008	4,309,520
Surplus	$2,158,386	$1,364,758	$1,441 582	$1,072,866
Total surplus	13,576,127	11,417,741	10,052,983	8,611,401
Miles wire	739,105	715,591	678,997	643,697
Offices	20,700	20.098	19,382	18,770
Messages	62,387.298	59,148,343	55,878,762	54,108 326
Tolls per message	31.6	32.5	32.4	31.2
Cost per message	22.3	23.2	22 7	22.4
The balance sheet shows:				
Accounts payable				$2,924,383
Cash				2,202,275
Balance due				$722,108
Accounts receivable				$2,088,599
Supplies				252,721
Real estate				3,313,918
Stocks and bonds				7,627,559

The bonded debt changed very little during the year, except that $52,000 of the collateral trust bonds were issued for Mutual Union, International Ocean and Gold and Stock stock, while sterling and building bonds to the amount of $15,000 were redeemed. Gross earnings increased $672,078 and operating expenses decreased $120,884; the latter because of the reduced cost of repairs on the Gulf and Atlantic cables of about $350,000, so that the operation of land lines cost about $230,000 more. The company paid about 60 per cent. of its entire expenses for salaries, the additional offices and additional business requiring more operators. Revenue for land line service increased $118,300. The company pays for all renewals and reconstruction out of earnings, and nothing is charged to capital except absolutely new property. The improvements on the New York buildings have been charged to capital account where strictly new, while the fire damage was charged to expenses. About $350,000 was charged to capital account for the ground and the annex to the building. The total charge to capital account for new property during the year was $1,287,158. The surplus has all been expended for new property, and the total surplus is $15,174,311, including the surplus previous to Oct. 1, 1881. Regarding the issue of new stock, capitalizing the surplus, the report says that the directors will later on decide upon the best method of distribution, but a considerable portion of the new capital will be held in the treasury for improvement purposes. At the annual election 530,000 shares of stock were voted for the following board of directors: Norvin Green, Thomas T. Eckert, John T. Terry, John Van Horne, Jay Gould, Russell Sage, Alonzo B. Cornell, George J. Gould, Samuel Sloane, Edwin Gould, Robert C. Clowry, Henry Weaver, Percy R. Pyne, Austin Corbin, J. Pierpont Morgan, Frederick L. Ames, John Hay, Wm. D. Bishop, John G. Moore, C. P. Huntington, George B. Roberts, Charles Lanier, Erastus Wiman, Charles F. Mayer, Chauncey M. Depew, James W. Clendenin, Sidney Shepard, Henry M. Flagler, Henry B. Hyde and G. Murray Crane. The two last-named gentlemen fill the vacancies caused by the deaths of Sidney Dillon and Cyrus W. Field. The executive officers were re-elected as follows: President, Norvin Green; vice-president and general manager, Thomas T. Eckert; vice-presidents, John Van Horne, Robert C. Clowry, and George J. Gould; acting vice-president and auditor, J. B. Van Every; secretary, A. R. Brewer; treasurer, R. H. Rochester; attorney, George H. Fearons. President Green says: "By order of the board of directors a meeting of stockholders has been called for the 25th inst. to vote on the question of authorizing an increase of $13,800,000 in the capital stock of the company, making the aggregate capital stock $100,000,000. In the last previous report it was shown that the surplus earnings remaining uncapitalized on the 30th of June, 1891, were $13,015,925. It has been shown in the foregoing statements that the surplus has increased during the year covered by this report, and was on the 30th of June, 1892, $15,174,310.94, to which several hundred thousand dollars have been added during the first quarter of the ensuing year. Of this surplus it is proposed to capitalize $13,800,000 by the issue of that amount of additional capital stock, and make the total capital stock an even $100,000,000."

American District Telegraph.—This stock sold on Monday at 60, a slight advance over previous quotations. A successful operator makes this point: The stock is selling lower than any other 5 per cent. stock of assured dividend in the market. It pays 5 per cent., and has a dividend of 1¼ due the middle of next month. It is earning considerably over 5 per cent., and on the first of November it will be in a position to take advantage of various economies. Leases which had to be carried out will then expire, and the company will be in a position to reduce its expenses without any decrease in gross earnings. The company has a long contract with the Western Union for the collection and delivery of messages, and it is wholly under Western Union management. It is almost probable that in due time it will be taken by the Western Union under some form of guarantee.

WALL STREET NOTES.

Official and Comprehensive.—The executive officers of the General Electric Company stated to a representative of The Electrical World that they preferred not to discuss the details of the electric lighting situation, except to state however, that they are entirely satisfied with the decision recently rendered, and have no doubts but that the Edison patent, as construed by the court, covers every possible form of incandescent lamp which can be commercially used. It is their duty to the users of their apparatus and to their stockholders to make the decision as valuable as possible, and the aid of the courts will probably be invoked to secure proper compensation for past infringement and protection of the business for the future, as far as may be necessary, and as prompt as possible. In regard to the rumor that Thos. A. Edison

had become dissatisfied with treatment received from the General Electric Company, we are informed by parties in authority that it is false and without the slightest foundation. Mr. Edison's relations with the company are exceedingly friendly and close. Mr. T. A. Pillsbury, of Minneapolis, whose name was associated with this alleged deal, has denied all knowledge of it.

Dividends, Opening and Closing of Books.—To-day the following dividends are payable: Western Union 1¼ per cent., Bell Telephone $3. Closing of books: Edison Electric Illuminating Company, General Electric. Books open: Western Union.

No Prospect of a Consolidation.—Concerning a rumored absorption of the Postal Telegraph by the Western Union, Mr. F. H. Tubbs, general western superintendent of the Western Union, says: "Such a sale would be arranged in New York and we would know nothing about it in Chicago until after it was consummated, but I am willing to hazard an opinion, however, and that is that the story is without foundation. Such stories are started frequently, but never as yet on authority. It is my opinion that this country is too big for one telegraph company." An official of the Postal company says: "There are two reasons why it is not so. First, the Western Union Company do not want to buy. Second, the Postal will not sell." Director John T. Terry, of the Western Union Telegraph Company, says that there is not one word of truth in the reports that the company has purchased the Postal Telegraph Company.

Westinghouse Won't Come In.—Mr. Westinghouse held a conference with Mr. Villard on Tuesday of last week, which led to a supposition that the Westinghouse and Edison people were coming together. After the conference Dow, Jones & Co. asked Mr. Westinghouse what he had to say about the matter. He replied: "The Edison people are trying to give the impression that we must consolidate with them to keep afloat. They would probably like to have it so. The fact is that we are going to stand alone as an independent company. We will keep right on with our business. Full explanation of the bearing of the recent decision has been made public, and further than that there is no need of any statement now."

That Lamp Decision.—A Wall street authority on electrical matters was interviewed last week with the following result: "The various statements put out by Westinghouse and his company's counsel and others in the same interest, assuring the public that the decision in the case of the Edison incandescent lamp is of little consequence to them; that it will not interfere with their current business; and further, that they already have a patented incandescent lamp that does not infringe the Edison patent, etc., etc., are simply absurd statements to break the force of the decision against them. 1st. The decision is final; it is in the broadest possible terms; it shows that not only all of the properties essential to a practical incandescent lamp are involved in the Edison lamp, but the invention of a commercial incandescent electric lamp, is wholly and absolutely the patentable and patented property of Thos. A. Edison, or his assigns. The decision in this case entitles the General Electric Company to an order absolutely preventing the Westinghouse Company from using the lamp at all, unless an arrangement is made to secure a license. 2d. I am certain that the Westinghouse Company does not hold a patent for a commercial incandescent lamp that will not infringe Edison's claims; also that the Westinghouse Company will not own such a patent during the life of the Edison patent, and, further, that no such patent has been issued to anybody."

Electrical Workers Strike.—The Advisory Committee of Local Union No. 9 of the National Electrical Workers, Chicago, called out on strike on the 13th inst. all employés of the Chicago Edison Company, Western Electric Company, Orne Company, Harter Company, and the Comstock Company, about 250 men. The trouble was caused by the refusal of the companies to sign the new agreement presented by the Advisory Committee, which calls for eight hours' work at the old scale of wages, and for all overtime as time and one-half.

Westinghouse Talks Back.—Officials of the Westinghouse Company are quoted by a contemporary as saying that the statement purporting to have been made by an expert of the General Electric Company that Westinghouse Company's advertisement of a new lamp is merely a threat is idle talk. The new Westinghouse lamp is a fact, and hundreds of them are already made, and are now in use, and their superiority over all other lamps is fully established. The success of lamps made in separable parts, so that the carbon burner can be replaced, practically cuts in two the cost due to lamps and renewals, and through its new inventions the Westinghouse Company expects to reap the benefits that will result from furnishing these lamps at reduced cost to the public.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Oct. 15, 1892, and the range for the week in New York:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Low-est.	High-est.	Bid.	Ask'd.
American District Tel....	100	3,825,000	60	60	59½	61
American Tel. & Cable..	100	14,000,000	86	87	85	87½
Central & So. Am. Tel....	100	6,000,000	....	....		
Commercial Cables.....	100	7,716,000	....	....	164	169
Gold Stock & Tel	100	5,000,000	..	....	100	103
Bonds.....	500	500,000	....	....	100	..
Postal Tel. & Cable.....	..	10,000,000	....	....	62	64
Southern & Atlantic Tel..	25	948,775	....	....	78	84
Western Union Tel.....	100	86,199 852	96½	99⅛	98⅝	100¾
Real estate bonds.....	1,000	1,219,000	....	....	....	..
Debenture bonds.....	1,000	4,920,000	....	....	..	....
Collateral Trust 5's....	1,000	8,181,000	....	....	....	....
North American.....	100	39,767,200	12¾	13⅞	13	13⅜
Brush Ill. Co. of N. Y.....	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.....	100	6,500,000	101¾	106½	105	107½
" " 1sts.....	...	.....	105½	106¾	...	..
" " 2 Deb's.....	...	.....	....	....	...	....
Edison El. Il. of Brooklyn.	100	750,000	...	....	85	90
" " " " Chicago..	100	750,000	....	....	130	145
" " " " Boston...	...	.....	....	....	115	125
Edison El. Lt. Europe....	1,000	2,000,000	....	....	2	6
" Bonds.....	...	30,000	....	.. ..	65	80
Edison Ore Milling Co....	...	2,000,000	....	....	15	20
East River El. Light.....	100	1,000,000	....	....		65
General Electric.....	1,000	50,000,000	116¾	119½	116¾	118⅞
Debenture 5's	....	.....	106	106¼	....	....
Automatic Exhibition Co. ...		2,500,000	. ..	....	3	5
Mt. Morris Electric.....	...	500,000	....	....	....	65
N. E. Phonograph.....	..	2,000,000	....	....	2	4
N. Y. Phonograph	...	2,000,000	....	....	2	5
N. American Phonograph ..		2,000,000	....	....	4	6
Westinghouse E. & M. Co. 1st p. 7 per cent. Cum.	50	3,717,253	....	....	....	....
E. & M. Co. Assg.....	50	5,038,116	77	77¼	....	....

The Copper Market.—The copper market closed this week very strong at 11¾c. to 11¾c. bid, and 11¾c. to 12c. asked for lake brands. During the recent advance consumers accumulated stocks which will last them over the greater part of the month. The fact that they have not made contracts for delivery beyond Nov. 1 in the face of the advancing market is construed to mean that the companies are discouraging such action by holding stocks at a high figure. We know that the Calumet & Hecla is asking 12 cents and some of the other companies a fraction less. They argue that at the close of navigation, which takes place about Nov. 1, the cost of copper delivered in New York will be one-half cent per pound more than the present cost, due to higher freight rates. It is because of this circumstance, as well as improved trade conditions, that the companies take a very independent stand, and are all bullish on the situation. Business among consumers is said to be very good, although prices are ruinously low. Last week sheet copper of a certain standard grade sold at 22 cents per pound, less 40 per cent., which means 13.20c. With the raw material costing 11¼ cents it can readily be seen that operations are being conducted without a profit. In the half dozen or more manufactories of various kinds of copper goods there are pools. Some of these are operated successfully. Others are practically a dead letter. We understand that there is a movement on foot to put them all on a solid basis. If these eventuate the effect upon the copper market will be stimulating. According to Henry R. Merton & Co. the stocks on hand in Europe and afloat thereto on Sept. 30 were 58,482 tons, a decrease of 1,236 tons in a month. Exports from the port of New York last week were 447,942 pounds of matte and 336,193 pounds of fine copper.

BOSTON, Oct. 15, 1892.

General Market Review.—The prevailing conditions of the week in the general market have made, as usual, many grumblers at the upward course which has characterized nearly all the principal stocks on the list. The bears have kicked at having to purchase back what they sold at lower figures, and many speculators find themselves with no holdings to give them the fine profits of this rise. The leaders are now on top, and no violent reactions are probable, however hard the bears may try it. Specialties have absorbed the majority of the dealings on the Exchange, but the broadening of the list is very evident, and no weak spots are apparent.

Boston Electric Stocks.—The Electrics have passed rather a quiet week, and have not proven so attractive as during the previous week, when the lamp decision enlivened matters very materially. General Electric gained five points on the boom that the decision of the courts gave it, and though a reaction was natural and expected still it was very slight, and the stock closes with this week where it opened at the beginning of the week. Opening strong at 119, it gradually weakened and fell to 117 on small sales. This loss it regained and on Friday sold again at 119, just before the dividend was deducted from the price. Later it closed at 117½ with the dividend of $2 off. The Thomson-Houston extra dividend of $1.20, payable Nov. 1, has just been declared, and has been a strong factor in maintaining the price of the General stock. Westinghouse shows very little fluctuation one way or the other, and the sales for the week have been very light. The boom of the General stock did not show an equal and opposite reaction in Westinghouse, thanks to the inside support of the latter, and also perhaps the company's circular on its new lamp. Detroit Electric fails to regain the three points lost by passing the dividend, but the official circular of the company, as published elsewhere in this column, explaining the wisdom of this action, shows that there is no evident weakness in the condition of affairs, and the intrinsic value of the stock is no doubt equal to what it ever was. A few sales of Fort Wayne and Series A are at the same price as formerly, showing no appreciable fluctuation, and evident strength in both. West End Railway stocks are very quiet and remain at about the same prices, with a slight tendency to advance. The enormous expenses of the extensive track repairing of the past summer, no doubt, tend to keep the stock quiet, and at a low figure.

Detroit Electrical Works.—The following is the official announcement of the Detroit Electrical Works in regard to the passing of the October dividend, of which no previous intimation was given: "The necessity for increasing the capacity of the shops and procuring additional tools and machinery to give enlarged facilities for developing the business, especially in new applications of electricity to railway, elevator, hoisting and mining work and other important specialties never before undertaken by us, has been strongly forced upon this company. In consequence of these demands active work in all these directions was commenced this year and is now well advanced. These enlargements and improvements to premises and plant call for a large outlay of money; but rather than make a further sale of stock—which is now limited to $750,000—the management, after mature consideration, has deemed it best to work upon a conservative plan and provide for this exceptional expenditure out of the earnings and resources of the company. The company will not, therefore, pay the usual quarterly dividend on the 15th of October next; and it is hoped the action and policy of the management will meet with general approval. By order of the board of directors. THOMAS MUIR, Treasurer."

The Walden (Mass.) Electric Company has declared the regular quarterly dividend of two per cent., payable Oct. 15.

Erie Telephone and Telegraph Company.—It is stated that the Erie Telephone and Telegraph Company will place as collateral behind its recent bond issue of $500,000 with the Boston Safe Deposit and Trust Company the following securities: 14,000 shares of stock of the Northwestern Telephone Exchange Company, 14,000 shares of the Southwestern Telegraph and Telephone Company, and 6,000 shares of the Cleveland Telephone Company. According to the last sales of these securities the value back of the bonds would be $2,000,000.

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.—Series C	sh	40,000	9	....	8½	9
Thomson-Houston Elec.—Series D.....	sh	120,000	8⅛	7⅞	8	8½
Thomson Elec. Weld.. ...	100	1,000,000	....	....	....	....
Thomson European Elec. Weld.....	100	1,500,000	10	....	....	10
Westinghouse Elec.—New Com.	..	6,000,000	39	37⅝	37¾	38¼
Westinghouse Elec.—Pfd.	..	4,000,000	50	....	49⅞	50
General Electric.....	..	30,067,200*	119	116½	117¼	117⅝
" " Pfd		4,136,300	118½	117¾	118¼	118½
Fort Wayne Elec.....	25	4,000,000	13	12½	12½	13
Fort Wayne Elec.—Ser. A.	sh	80,000	8	....	7⅞	8
Detroit Elec.....	10	750,000	5¼	5	5	....
West End St. Ry. Co.—Com	50	7,150,000	72½	72	72¼	72½
West End St. Ry. Co.—Pfd	50	6,400,000	87	..	87	87¼
American Bell Tel	100	15,000,000	208	202½	207	208
Erie Tel. & Tel. Co.....	..	4,800,000	47	46¼	46¾	47½
Mexican Tel. Co.....	10	1,280,000	....	....	....	1.10
New Eng. Tel. & Tel. Co..	..	10,304,600	61	60	60	60½
Tropical Tel. Co.....	10	400,000	....	....	....	10c

* Ex dividend.

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago.....	214	....	Chicago Arc Light & Power Co.....	102	104
Central Union	56	57½	Chicago Edison Co ...	160	..

NEW INCORPORATIONS.

The Allen-Hussey Company, of Chicago, Ill., capital stock $10,000, has been formed to manufacture electrical apparatus of all kinds, etc. Wm. R. Allen, Alfred R. Hussey and Nels A. Erickson are the promoters.

The Hearne Electric Light Company, of Hearne, Tex., capital stock $10,000, has been formed to supply electric light to that town. Peter L. Brady, Mary Brady and Em. Brady, all of Hearne, are the incorporators.

The Ravenswood Electric Company, of Ravenswood, Ill., capital stock $10,000, has been formed to furnish electric light and power to residences, etc. Preston W. Gray, Harry O. Mackenzie, and John T. Parker are the incorporators.

The Harvey Electric Company, of Harvey, Ill., capital stock $10,000, has been formed to operate, equip and construct a street railway, with necessary appurtenances. F. O. Young, J. C. Bloodgood, G. P. Waring and W. T. Mills are the incorporators.

Reynoldton and Port Vue Traction Company, of Reynoldton, Pa., has been formed to construct and operate an electric railroad in Reynoldton and Port Vue, Pa. A. Chandon, James Simpson, and J. A. Caughey, of McKeesport, Pa., are the promoters.

The Citizens' Passenger Railway Company, of McKeesport, Pa., capital stock $30,000, has been formed to construct and operate an electric railway in McKeesport. The organizers are W. A. Dunshee, W. E. Harrison and J. A. O'Neil, of McKeesport.

The Electric Power Company of Wilmington, of Chicago, Ill., capital stock $1,000,000, has been formed to do a general electric light, heat and power business. Charles B. Holmes, Joseph E. Truitt, and James Anthony are the promoters.

The Amityville Electric Light Company, of Amityville, N. Y., capital stock $20,000, has been formed to produce electricity for light, heat and power. Stephen H. Williams, Joel S. Davis, of Amityville, and William Blake, of New York, are the parties interested.

Hanover & McSherrystown Street Railway Company, of Hanover, Pa., capital stock $30,000, has been formed to construct and operate an electric railway in Hanover Pa. Aaron Hostetter, John C. Tanger and C. E. Ehrenhart, of Hanover, Pa , are the incorporators.

The Selma Photo Electric Manufacturing Company, of Kittery, Me., capital stock $10,000, has been formed to manufacture and deal in electric goods, etc. Jno. F. Ivarson, Gustaf Libert Reenstierna, G. A. Harring and Carl Rosendahl, all of Boston, are the incorporators.

The Hummelstown Electric Light, Heat and Power Company, of Hummelstown, Pa., capital stock $10,000, has been formed to supply light, heat and power to the public at Hummelstown. W. H. Ulrich, Allen Walton, and W. C. Baker, of Hummelstown, Pa., are the promoters.

The Grand Forks Electric Street Railway Company, of St. Paul, Minn., capital stock $100,000, has been formed to generate and sell electricity, etc., to construct, own and operate street railways, etc. G. F. Arral, W. G. De Gelle, F. C. Stevens, all of St. Paul, are the promoters.

Citizens' Light and Power Company, of Rochester, N. Y. capital stock $150,000, has been formed to produce electricity for light, heat and power. James W. Gillis, 273 E. avenue; Robt. M Myers, 101 Meigs street, and H. Wheeler Davis, 93 Ambrose street, all of Rochester, are the promoters.

The Butte General Electric Company, of St. Paul, Minn., and Butte, Mont., capital stock $600,000, has been formed to manufacture, sell and supply electricity, etc., etc. Jesse R. Wharton, Butte, Mont.; Howard C. Lewis and Henry M. Byllesby, of St. Paul, Minn., are the incorporators.

The Benson Electric Belt Company, of Ottawa, O., capital stock $30,000, has been incorporated to manufacture and deal in electric belts and applications, mechanical and medicinal electric machines, etc. Allen Smalley, M. A. Smalley, A. Billhardt, Hattie T. Smalley and Chas. N. Haskell, are the organizers.

The Helios Electric Company, of Philadelphia, Pa., capital stock $100,000, has been formed to manufacture, contract and furnish all articles, apparatus, machinery, equipment, etc., for the use and application of electricity. D. C. Spruance, Frank Marr and T. J. Johnson, all of Philadelphia, are the promoters.

The Pittsburg Land Company, of Seattle, Wash., capital stock $300,000, has been formed to construct and operate railroads gas and electric light works, etc. H. L. Thomas, J. S. Patterson, Abram Barker, of Seattle; S. J. Wainwright, Jr.; E. W. Heyl, James Benney, J. A. Wilson, J. C. Patterson, and W. L. Kier, of Pittsburgh Pa., are the incorporators.

The Twenty-third Avenue Electric Railway Company, of Oakland, Cal., capital stock $300,000, has been formed to construct and operate a street railroad in Oakland. B. C. Hawes, San Leandro; A. C. Hammond, Jr., Alameda; H. W. Meek, San Lorenzo; William Landers, San Leandro, and C. E. Palmer, of Oakland, are the parties interested.

The Pacific Grove Electric Light and Power Company, of Pacific Grove, Cal., capital stock $60,000, has been formed to generate and deal in electricity for light, heat and power, and to operate telephone lines, etc. Nathan C. Garnall, Geo. W. Hopkins, San Francisco; H. N. Bryant, Henry E. Kent and Wm. H. Chapman, of Pacific Grove, are the organizers.

The General Incandescent Arc Light Company, of New York, capital stock $250,000, has been formed to manufacture, purchase, lease and sell all kinds of electric lamps, etc. Sigmund Bergmann, 59 Duane street; William H. Meadowcroft, 141 Broad street, both of New York, and Clement M. Biddle, 813 Arch street, Philadelphia, Pa., are the promoters.

The Wichita-Wilder Duplex Electric Burglar Alarm and Messenger Company, of Denver, Colo., with a capital stock of $50,000, has been formed to sell burglar and fire alarms, messenger service and night watch service under the Wilder Duplex Electric Company, of New York. R. H. Smith, J. Moore, A. G. Walden, all of Wichita, Kan.; W. L. W. Miller, of Denver, Colo., and Wm. H. Smith, of New York City, are the incorporators.

AFFAIRS OF THE COMPANIES.

The Wagner Electric Manufacturing Company, of St. Louis, Mo., has increased its capital stock from $25,000 to $100,000.

Post & Co., dealers in electric supplies at No. 415 West Forty-eighth street, made an assignment in favor of their creditors. The failure was due to an unexpected rush of creditors. The assets are estimated at $90,000, and the firm claims that this amount will cover the liabilities.

Mansfield Electrical Manufacturing Company, which was recently incorporated with a capital stock of $50,000, has organized by the election of the following officers: President, Reid Carpenter; secretary and treasurer, F. B. Black. Directors—Reid Carpenter, F. B. Black and Moses Black, and W. R. Mason and W. L. Adams of Chicago.

The Boone (Ia.) Electric Street Railway and Light Company, capitalized at $200,000, has elected as directors E. H. Chandler, Chas. French, L. W. Reynolds, C. E. Rice and S. T. Stanfield. The directors have elected the following officers: President, L. W. Reynolds; vice-president, E. H. Chandler; treasurer, C. E. Rice; secretary, Chas. French; manager and assistant secretary, S. T. Stanfield.

The Susquehanna Electric Light Company.—At the annual meeting of the stockholders they elected the following directors: J. G Brewer, M. H. Eisman, C F. Wright, J. J Ahearn, J. H. Cook, Thos. Kelly, E. W. Jackson. The board of directors has elected the following officers for the ensuing year: President, John Brewer; vice-president, Thomas Kelly; secretary, A. W. Cook; treasurer, C. F. Wright.

The Missoula Electric Light Company, of Salt Lake City, has sold its plant and franchise to the Thomson-Houston company for $75,000. It is stated that the new owners will immediately commence the erection of a power plant on the river two miles above the city. Negotiations are nearly completed by which they will acquire the tracks and franchise of the Missoula Street Railway, and an electric line will be installed.

The Directors of the United States Rubber Company held a meeting on Saturday, Oct. 15, to complete the permanent organization. This company was incorporated under the laws of the State of New Jersey with a capital stock of $50,000,000, and controls the principal companies manufacturing rubber boots and shoes in the United States. President C. A. Coffin of the General Electric Company was chosen one of the directors.

The New Central Electric Company, of Minneapolis, met on Oct. 10 and elected the following officers: President, E. S. Corser; vice-president, H. M. Byllesby; secretary, A. M. Robertson; treasurer, A. B. Barton. The new company will continue the two power houses as at present, but the Edison offices in the Lumber Exchange will be abandoned and the new company will occupy the offices of the late Brush company at 9 and 11 Washington avenue, North.

The Cooper-Hampton Electric Company has elected the following board of directors: John Martin, J. S. Pillsbury, P. D. McMillan, S. C. Gale, Loren Fletcher, P. B. Winston, E. M. Johnson W. K. Morison, C. M. Loring, C. H. Chadbourn, C. P. Lovell, F. C. Barrows, C. H. Woods, J. M. Shaw, C. H. Maxey, A. W. Hastings Wm. Cooper, F. N. Walcott. The new directors elected the following officers: President, John Martin; vice-president, J. S. Pillsbury; secretary, A. W. Hastings; treasurer, F. N. Walcott.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Oct. 17, 1892.

Mr. Lewis R. Shultz, treasurer of the Pennsylvania Electric Engineering Company, of Philadelphia, made us a pleasant call last week. He reports several large contracts as closed by his company of late and that business is most satisfactory.

Electric Lights on Fifth Avenue.—The new system of electric light has been installed by the Edison Illuminating Company on Fifth avenue, and has been in operation during the past week. It works with entire success.

The American Telephone and Telegraph Company has issued invitations for the opening of its long distance lines between New York and Chicago, which will take place at No. 18 Cortlandt street, New York City, on Tuesday, Oct. 18, 1892, at 4 o'clock in the afternoon.

The Clark Electric Company, 192 Broadway, corner John street, illuminated its offices with its fine system of arc lighting during the Columbus parade on Wednesday night. The light could be seen as far down Broadway as Trinity church and Wall street, and the entire length of Dey street. Since last Friday it has displayed one of the finest American flags on Broadway, from the front window of its office.

New York Talks with Chicago.—The first practical use of the long-distance telephone between New York and Chicago was made on last Tuesday, when President Hudson of the American Telephone and Telegraph Company at Chicago called up Vice-President and General Manager Hall in New York. The conversation could be heard as distinctly as if only one mile separated the speakers, instead of 1,000.

The Board of Aldermen at a meeting held on last Monday to reconsider the application of the Metropolitan Traction Company for an extension of the Ninth avenue surface railroad, passed the resolution with the following amendment: After the words "to be operated by power other than horses or locomotive steam power," to be inserted the words "or the power known as the trolley system, or any motive power operated by means of electricity through an overhead wire."

The Storage Battery in New York.—Several months ago it was announced that the Waddell-Entz Company had secured the contract to equip the Second Avenue Street Railroad with a storage battery system, but no detailed information was given at that time. The Waddell-Entz Company now states that it is to place in active service on the Second Avenue line ten cars of the regulation style, 16-foot bodies and palace finish, equipped with the Waddell-Entz slow-speed, single reduction motors, driven by the storage batteries of the same company. The batteries will be removed from the end of the cars instead of the side, as usual. A power plant containing direct-connected dynamos, safety boilers and a complete equipment will be erected at once.

ALBANY, Oct. 15, 1892.

A decision has been rendered by Judge Maynard, of the Court of Appeals, reversing the order of the General Term in the case of the Hudson River Telephone Company vs. the Watervliet Turnpike and Railroad Company.

The village trustees of West Troy will investigate the action of the Albany Railway in discontinuing the running of cars on the branch of the road north of the Congress street bridge. Considerable unfavorable comment has been aroused.

A system of air brakes is being experimented with by the Buffalo Electric Railway Company. President Watson says that the air brakes are merely an experiment and he cannot say what will be done by the Buffalo road as to adopting them on its lines.

A motion has been made in Special Term to substitute the Central Trust Company, of New York, as a trustee of the mortgage against the Seneca Electric Railway Company. The road extends from Waterloo to Seneca Falls, and a mortgage of $40,000 was made to the American Loan and Trust Company as trustee. The latter company became insolvent, and consequently this motion was made.

At the annual meeting of the stockholders of the Albany Railway the following were elected directors for the ensuing year: Anthony N. Brady, A. Bleecker Banks, Andrew S. Draper, Hon. James H. Manning, James McCredie, John G. Myers, John W. McNamara, William McEwan, Robert C. Pruyn, James Rooney, Simon W. Rosendale, Elnathan Sweet, J. Irving Wendell. Messrs Frederick Harris, Francis B. Delehanty and Thomas H. Craven acted as inspectors of election.

PHILADELPHIA NOTES.

PHILADELPHIA, Oct. 15, 1892.

A change of partnership in the firm of the Howard Foundry and Machine Company will soon be announced.

The La Roche Electrical Works will be represented at the American Street Railway Convention at Cleveland by Mr. L. B. Whitney.

Mr. Walter F. Smith, general manager of the Heisler Electric Company, has gone to Florida and expects to remain there for a few weeks.

Mr. J. G. Hendrickson, president of the Ajax Metal Company, has gone West on a business trip and during this trip he will visit some of the principal Western cities, and will return in about three weeks.

The Pennsylvania Railroad Company will shortly erect a power-house in the vicinity of Holmesburgh Junction, Pa., for furnishing power for the new system of interlocking signals which the company will put in between the Broad street station and Holmesburgh Junction.

The Penn. Steel Company will be represented at the Street Railway Convention by Mason D. Pratt, engineer of the Street Railway Department; John F. Ostrom, manager Railway Department, Philadelphia, and Charles S. Clark, sales-agent Boston, Mass. The exhibit of this company will consist of rail sections, and probably samples of special work.

PITTSBURGH NOTES.

PITTSBURGH, Oct. 15, 1892.

Mr. Nikola Tesla was a guest of Mr. Albert Schmid, of the Westinghouse Electric and Manufacturing Company, during a few days last week.

Mr. Howard Wheeler, now connected with the *Street Railway Journal*, but formerly agent of the Thomson-Houston company in this city, was a visitor in Pittsburgh a few days ago. Mr. Wheeler has still a number of friends and well-wishers here, and they will be all glad to see him again.

Mr. Percy F. Smith, who owns the largest printing and lithographing establishment in Western Pennsylvania, and whose place of business is in this city, has recently installed a direct current power generator in his place of business, and he is now operating his entire plant, the printing presses, etc., by electric power.

The West End Street Railway Company will shortly commence to run electric cars on all its lines from this city to Temperanceville and Chartiers. The electric motors have already been put on them and the power-house apparatus is now being installed. It is expected that the entire work will be completed by the first of December.

The Pittsburgh Electric Club is taking on an entirely new lease of life for the coming winter, and the board of directors of that organization are already making great promises as to what they intend to do during this season. Mr. Morris Mead, the president, ever active and on the alert for anything which might enhance the many alluring characteristics of the clubhouse, has a programme mapped out, which will undoubtedly be heartily appreciated by all the members. He has succeeded in obtaining the assurance from a number of the best lecturers on electrical topics, that they will visit the club this winter and entertain the members with interesting matter. Among these gentlemen, Mr. Nikola Tesla, who is even more popular in Pittsburgh than he is in London and Paris, if that were possible, is to be one of the lecturers, and every member of the club is anxiously looking forward for the Tesla lecture.

The Central Traction Company of this city has recently completed an arrangement on its street railway line by which it will greatly augment the travel on the road. This line was originally operated by cable only, but about a year ago the company constructed a branch line and adopted the Westinghouse electric motor system as the motive power for running the cars on this branch line. Last week, however, the company completed the overhead wire work over its entire lines, and now the road can be operated either as a cable or an electric road. The advantage of this arrangement is obvious, because it renders the constant operation of the road far more permanent than it could be if only the cable system were operated. Owing to the fact that the electric system allows cheaper operation of the road, the company has also introduced an all-night schedule, and the public along the lines now enjoy what is a rare luxury in Pittsburgh—an all-night electric car.

The New Central Station plant of the Allegheny County Light Company of this city is now under roof and a number of the arc dynamos operated by the company are already installed in the new plant. When this station is completed it will probably be the largest central station electric lighting plant in the country, having a floor space for the accommodation of electric lighting dynamos of a capacity of 125,000 16-c. p. incandescent lamps. The Allegheny County Light Company, which, by the way, is one of the oldest electric light companies in the country, has hitherto occupied a plant on Virgin alley in this city. Its capacity there was about 50,000 incandescent lights and 1,500 arc lamps. The station, however, has been for a long time too small, and as the demand for lights has wonderfully grown of late the company has had the erection of a new plant under contemplation for quite a while. This new station when completed will contain some of the largest and latest Westinghouse electric lighting generators and all the central station appliances will be of the most modern and approved type, so as to make the plant not only one of the largest, but also one of the finest central station plants in the United States.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Oct. 15, 1892.

Col. Burnham, of the Electric Gas Lighting Company, has returned from his Western trip. He reports business very good in his various lines.

Mr. H. E. Swift, vice-president of the Framingham Brass Manufacturing Company, of South Framingham, Mass., was a recent visitor to this office.

Mr. J. Bradford Sargent, Eastern representative of the Stirling Boiler Company, of Chicago, reports a recent sale of a 200-h. p. Sterling boiler to the Hyde Park Electric Company.

Mr. C. A. Baldwin, president of the Massachusetts Chemical Company, the manufacturer of the well known "Insullac," reports that he is hearing from the trade in a very substantial manner.

The Whitney Electrical Instrument Company is now occupying a very attractive suite of offices at 146 Franklin street, Boston, and has on exhibition a number of its voltmeters and ammeters.

Mr. Swan, of the firm of Swan & Lane, of this city, on his recent trip to Maine succeeded in securing some very nice orders. This is in spite of Mr. Swan's assertion that his trip was merely one of pleasure.

Mr. Louis McLaughlin, son of the Hon. Hugh McLaughlin, of the Citizens Electric Illuminating Company, Brooklyn, N. Y., who has entered the factory of the General Electric Company, at Lynn, to take up the alternating current course, was a recent visitor at this office.

The Redding Electric Company, Boston, Mass., reports that it is overrun with orders for its newly designed and lately patented Iona snap switch, and is very enthusiastic in its praise of THE ELECTRICAL WORLD for bringing about such gratifying results. Mr. Nichols, the treasurer and manager, is a live business man, and has brought before the attention of the trade something which they appreciate.

Fenders for Electric Cars.—The Commission appointed by the president of the West End Street Railway Company to examine the merits of fenders for use on the electric cars of said company submitted its report to the Boston Board of Aldermen. The Commission recommends that the Cleveland platform with buffer, combined with the Hurt fender operated by the brake handle, be attached to both ends of all the electric cars of the West End street railway system.

The New England Electric Club at the recent meeting elected A. C. Shaw secretary. This was the only matter of a business nature which was concluded. From a social standpoint the meeting was in every sense a success, as the club rooms were crowded with members and their friends. The musical part of the programme was much enjoyed, particularly Mr. Thomas H. Bibber's banjo selections, and the others who might be mentioned as contributing to the success of the occasion are its genial president C. S. Knowles, and Mr. Record, vice-president.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Oct. 15, 1892.

Mr. Nikola Tesla has promised to deliver a lecture at the meeting of the National Electric Light Association in St. Louis, Mo.

Mr. William E. Smith, auditor of the National Electric Manufacturing Company, is a World's Fair visitor this week, as the guest of Captain M. A. Knapp.

Mr. M. B. Austin, after six years' connection with the Western Electric Company, has allied himself with the Knapp Electrical Works, 51-56 Franklin street, Chicago.

Mr. E. R. Crolius, the manager of the Chicago Electric Manufacturing Company, 73 West Jackson street, Chicago, has secured the patents for his new electric fixtures and will shortly place the same in the market.

Mr. Charles Wilson, the Northwestern agent of the Babcock-Wilcox company, has just sold a battery of Babcock & Wilcox boilers to be used by the Hamilton Ore Company's electric light station at Biwabik, Minn.

Mr. Thomas G. Ayers, the cashier of the First National Bank, Coffeyville, Kan., who was severely wounded in the late raid by the Dalton gang, is the secretary and treasurer of the Coffeyville Electric Light and Power Company.

Mr. C. T. Yerkes, president of the North Chicago Street Railway Company, has presented the Chicago University with a telescope, the cost of which will probably exceed $500,000. It will be the most powerful telescope in the world.

The Marquis de Veraqua, a descendant of Columbus, will, it is said, open the World's Fair at Chicago on May 1 from Madrid by pressing a button which will establish electric communication through a transatlantic cable and set in motion the machinery.

Mr. S. A. Douglas, the new manager of the Chicago office of the Brush Electric Company, is making friends on every hand, and fast taking up the work that will be dropped by Mr. Kempt, who will shortly relinquish all responsibilities and take an extended and well-earned vacation in Europe.

Mr. George W. Atkinson, the city selling agent of the Page Belting Company, is meeting with the success that always follows persistent application, though some credit must be given to the host of friends that Mr. Atkinson won during his nine years' service with the Thomson-Houston company.

Mr. William D. Ray, formerly electrician of the Chicago & Northern Pacific Railroad Company, has accepted a position in the Chicago office of the C. & C. Electric Motor Company, and, together with Mr. H. L. Wills, will install all motors and generators in the district covered by the Western office.

Among the World's Fair visitors in Chicago during the past week were Messrs. P. Theodore Stahl and A. Faiveley, engineers of the Creuzot Works in France; Mr. John L. Markle, of Detroit; Electrician Opperman, of the Steuben Lamp Company, Canisteo, N. Y.; J. M. Fair, of the Lockwood Press, New York; General Manager Wheeler, from the Eclipse Clutch Works, Beloit, Wis.

The Jeffrey Manufacturing Company, of Columbus, O. is soon to put a new motor upon the market, for which Mr. Jeffrey and Mr. Miller anticipate a good sale. The company has been doing a nice business with its motor for mining purposes. In fact, the business of the Jeffrey company has outgrown the factory capacity. An additional building has just been completed, however, which will enable the company to very much increase its output.

The Electric Appliance Company reports great activity in all lines of its business. The company is working overtime with a largely increased force, and is only enabled to keep up with its orders with great difficulty. It also seems to be crowding the factories which it represents to their utmost. The Elkhart transformer factory is working day and night. The Packard Lamp Company is crowded almost beyond its capacity, and the Paranite people are doubling their force.

World's Fair Lighting.—The Westinghouse Electric Company has already shipped two 4,000-light generators for the World's Fair, and the first of the large incandescent lighting dynamos is nearing completion. There will be 12 of these large machines, six of which will be driven directly by the engine shafts of the Westinghouse engines, and the others by engines supplied by other exhibitors. The work on the whole of the 12 machines required for the lighting of the Fair is well advanced.

A False Report.—The rumor that Mr. Byllesby and Mr. Howard C. Levis were about to form a new supply house is flatly contradicted by those gentlemen. This rumor probably originated in the publication of the articles of incorporation of the Minneapolis General Electric Company, in which the names of Messrs. Byllesby and Levis appear as incorporators. This is merely a lighting plant which consolidates certain existing interests, and Mr. Byllesby and Mr. Levis are connected with the General Electric Company of New York and the Northwest General Electric Company of St. Paul.

The Chicago Incandescent Light Company has been entirely reorganized, and Mr. Thomas Pray, Jr., is the general manager and electrician, and Mr. Stephen Lissenden the president and treasurer of the new company. The factory has been entirely

renovated and equipped with the latest improved machinery for the manufacture of incandescent lamps of from 50 to 125 volts in various candle powers, as desired. This company is also manufacturing a special lamp that is said in no wise to infringe patents now in force, and will be glad to correspond with users of incandescent lamps on receipt of communications addressed to their office and factory, No. 75 N. Clinton street, Chicago.

The Minneapolis General Electric Company is the corporate title of a new organization having its principal place of business in Minneapolis, Minn. This company was formed on Sept. 1 as a local lighting company, having in view the consolidation of certain existing lighting and power interests. Mr. H. M. Byllesby and Howard C. Levis, of the Northwest General Electric company, of St. Paul, and Mr. Thomas Lowry, the street railway magnate, together with the principal stockholders of the local Brush and Edison companies, are the incorporators of the new company. This new company, rumor to the contrary notwithstanding, does not propose to enter into the supply business or act as agents for any other line of electrical machinery.

NOTES FROM DAYTON, O.

Two good turbine water wheels are manufactured at Dayton.

The Dayton Manufacturing Company, of which Mr. John Kirby, Jr., is general manager, is experimenting with a new storage battery which gives promise of good results.

The Smith & Vaile Company, manufacturers of steam pumps, are doing more business with electrical companies than they ever did before. Their agents in New York, Chicago, Cleveland and other cities make a similar report.

The Dayton Fan Motor Company, of which E. C. James is manager, has been doing so large a business during the past summer that it is making arrangements to extend its scope quite considerably, and we shall probably hear even more of the company next year.

Mr. John Fletcher, manufacturer of electrical specialties, is kept about as busy as he well can be to keep up with his orders. Mr. Fletcher's specialties seem to sell themselves. They are handled by practically all the electrical supply houses, and in the aggregate there must be a large volume of business done in them.

The Dayton Globe Iron Works, of which Captain Wood is president, and Mr. R. R. Dickey, Jr., secretary, manufacture another excellent wheel, the American, which is not as well known among electrical companies as it ought to be. Quite a number of the "American" turbines, however, have been furnished for running electric light and electric railway plants and they are giving splendid satisfaction.

The Stilwell & Bierce Manufacturing Company, of which Mr. J. N. King is secretary, pays considerable attention to orders from electrical and street railway companies, and is doing a large business in this field. For instance, a 42-inch cylinder gate horizontal "Victor" turbine has just been completed for the Columbia, S. C., Electric Railway Company, the electrical equipment for which is being furnished by the Short company, of Cleveland.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Oct. 5, 1892.

Electrical Traction on the South Staffordshire Tramways.—It is expected that the first electric cars on the overhead trolley system will be running within the next month or six weeks on the South Staffordshire tramway system. The trolley has been adopted by the company's manager for outside cars. Each car with his motor and gearing will have a weight of six tons and will accommodate 40 passengers. The mileage of this company's lines is between 20 and 30.

Electric Lighting Companies and Their Customers.—It has become a common custom in this country for electric lighting companies to grant rebates to large customers on their quarterly bills. Recently several central station concerns have inaugurated a tariff theoretically more correct, but which seems too complicated for the average mortal to understand. By this latter method, customers have increasing reductions made on their quarterly bills, upon the basis of the number of Board of Trade units per lamp installed, irrespective of what the total consumption may be. This is undoubtedly the most equitable to the consumer and the most advantageous to the company, since it offers relief, not only to the large, but also to the small consumer, and tends to prevent the fixing of an unnecessarily large number of lamps. The great objection hitherto to this more scientific tariff has been that the rebates by which it attracts customers are in a large measure illusory. In London, 10 shillings per annum per 8 c. p. lamp connected is about the average income; at 7d. per unit, this is equivalent to a consumption of 17 kilowatt hours per annum, which in turn means that each so-called 30 watt lamp connected to the mains is alight for under 600 hours per annum, or about 1½ hours per diem. Now in a large manufacturing town in the North of England no reduction whatever is granted until the quarterly consumption has reached the equivalent of every lamp installed having been alight 250 hours, or on an average nearly three hours per day. In the town in question, therefore, the average customer will have to burn his lamp something like twice as long as is customary in London before he becomes entitled to benefit by the sliding scale. The whole idea in fact is too complicated for every day use by ordinary people.

The Resistance of Metals at Low Temperatures.—The *Philosophical Magazine* for October contains a preliminary account of some highly interesting investigation by Professors Fleming and Dewar on the electrical resistance of pure metals and alloys at exceedingly low temperatures. Measurements were taken at temperatures ranging from the boiling point of water (100° C.) to the boiling point of oxygen (182° C.). The most striking fact elicited by this research is the enormous decrease in specific resistance experienced by perfectly pure metals, when cooled down to these abnormally low temperatures. Thus the specific resistance of copper at the boiling point of oxygen is only one-sixteenth of what it is at the boiling point of water and that of iron is only one-twenty-third. The results plotted out as curves (temperatures, ordinates, specific resistances, abscissæ) go to show that at absolute zero the specific resistance of the pure metals is in all probability absolute zero also. The low temperatures employed were also very sensitive detectors of impurities. For instance, two samples of nickel, one nominally pure, the other so in reality, both exhibited much the same specific resistance at 0°C., but at 182°C, the pure specimen gave the figure 1,900 C. G. S. units, while the impure article gave 6,737. In the case of alloy the curves, which are approximately straight lines, show no tendency to pass the origin at absolute zero. When the alloys are compounded of chemically dissimilar metals, such as platinum-silver, the deviation from the vertical is slight. On the other hand when the constituents are chemically similar (platinum-iridium) the deviation is more pronounced, resembling that of impure metals. Another fact of interest elicited by Profs. Dewar and Fleming is that down to 182° C., at any rate, carbon continues to behave as an electrolyte; *i. e.*, the colder it is the higher is its specific resistance. Experiments are now under way on selenium, sulphur, antimony, arsenic and various insulators.

News of the Week.

THE ELECTRIC LIGHT.

Greenfield, Ind., is putting in electric lights.

Dunkirk, N. Y., is to have an electric light and power plant.

Hutchinson, Kan., is agitating the question of an electric street car line.

Panora, Ill., has let the contract for an electric light plant and water-works, to be completed by Dec. 1 and Jan. 1 respectively.

Marshall, Mich., has ratified the contract with the Brush Company for an arc and incandescent electric light plant at a cost of $14,000.

Whitehall, N. Y., has contracted with T. D. McLachlin for the lighting of the town by electricity, the plant to be running within 60 days.

Rockville, Conn., has voted in favor of the town running its own electric lighting plant. The local electric light company has raised its price to $80 a light per year.

Mount & Jones, Radford, Va., have been granted an electric light and power franchise for the term of 20 years. The installation will consist of a 1,000-light alternating dynamo manufactured by the Fort Wayne Electric Company and a 100-light arc machine made by the same company. The Radford Street Railway Company has awarded the contract for building its road to W. H. Mackay & Co., of Roanoke, Va. The length of the road is about 3½ miles.

THE ELECTRIC RAILWAY.

The Pawtucket (R. I.) Common Council has granted the Union Railroad Company the right to operate the trolley system on its Elmwood and Pawtucket routes.

The Kingston (N. Y.) City Horse Railroad Company has decided to operate its present line by electricity, as well as the new one which is under construction.

The Poughkeepsie (N. Y.) Street Railroad Company has passed into the control of George W. Mansfield, of Boston, and it is the intention to equip the line with electricity.

The Denver, Lakewood & Golden Railway Company, has filed a certificate with the county clerk at Denver, Colo., by which it is to have its route into Barnum in full operation by Jan. 1, 1893.

The Citizens' Street Railway Company, of Memphis Tenn., has accepted the entire electric system and a complete settlement has been made between it and the Edison General Electric Company.

The Brooklyn, Bath & West End Railroad, which runs from the Thirty-ninth Street Ferry, Brooklyn, to Coney Island, is discussing the advisability of changing its motive power from steam to electricity.

The Sing Sing (N. Y.) Electric Road Company has given the contract for the construction of its line to Lake & McGonigal, of Hudson. The trolley system is to be used and the road is to be in operation by Jan. 1.

The New Brunswick (N. J.) City Railway Company has made application to the Common Council to operate its cars by electricity with the intention of extending its present line throughout New Brunswick, and toward towns adjacent to the city.

The Elizabeth & Plainfield Street Railway Company, of New Jersey, has filed articles of incorporation and will construct a road through Linden and Cranford townships. The road will be seven miles in length and will be operated by electricity.

The City & Suburban Railroad Company of Baltimore, Md., has awarded to Messrs. E. D. Smith & Sons the contract for the track construction on the York road line inside the city limits. Work was begun at once, girder rails being used. The work of laying the T rails north from the city limits to Towson has also commenced.

An Electric Line to the Lake.—The project of building an electric line from St. Joseph, Mo., to the stockyards and Lake Contrary has at last been placed on a substantial basis, and the road will be constructed immediately. Judge Owen Spencer, H. R. W. Hartwig, John Frazer and others have taken the matter in hand. The line will be four miles in length.

The St. Louis & Chicago Electric Railroad has been formally dedicated and the actual work of construction has commenced. Work was begun at Edinburgh, Ill., and Miss Alice Adams, the nine-year-old daughter of Dr. Wellington Adams, first broke the soil by a tiny pick in the presence of Dr. Adams, Prof. Nipher, of Washington University, Dr. Stedman, Judge Austin M. Young and others.

The Whiting, Hammond & East Chicago Railway Company has asked the East Chicago town board for the exclusive right to construct an electric line on 151st street from the western limits to Olcott avenue, thence north on Chicago avenue, west to Forsyth avenue, and north on Forsyth avenue to the limits. From that point the company will use the public highway to the Whiting and Robey race track, where the road is to connect with one from South Chicago.

The Milwaukee (Wis.) Street Railway Company will at once begin the erection of another power-house, which will be an exact duplicate of the large one on River street. It will be built on land between the company's extensive car barn on Kinnickinnic avenue and the water front, and the two buildings will be connected by a viaduct over the railroad track. It is so situated that supplies may be delivered direct from the lake or railroad. A new paint shop is also to be constructed.

The Dubois (Pa.) Electric Light, Power and Heat Company has sold its entire plant and business to Capt. M. D. Wayman, president of the Dubois Passenger Traction Railway Company. The plant will be conducted separately from the street railway station, yet the two will be consolidated for the sake of economy in running expenses. The entire machinery at the street railway power house will be moved to the electric light building, and the latter will be enlarged and its capacity greatly increased.

The Baltimore & Curtis Bay Electric Road is being rapidly double tracked. The capacity of the power station is being increased by the addition of a 200-h. p. boiler, a 150-h. p. Armington & Sims compound engine and a 150-h. p. Edison generator. Additions are also being made to the engine room and car sheds, in the basement of which will be a machine shop with special facilities for the repairing of armatures. The experiment of hauling local freight over the road will shortly be tried, a car 30 ft. ×8 ft. being provided for the purpose. The road is said to be in a prosperous condition.

The Washington-Baltimore boulevard and electric road project, which has been discussed for so long a time, is, it is reported, now assured. Preliminary work has begun, and within the next 30 days eight corps of engineers will be put on the ground to survey the route. The line will be constructed with a double track, and will be stone ballasted, so as to admit of the running of cars or trains at a speed of 60 miles an hour. Prominent men of Baltimore and Washington are interested in the scheme, and it is said that sufficient capital has been subscribed. It is also proposed to extend the line to Philadelphia. The new company was incorporated in the District of Columbia by an act approved Aug. 1, 1892. The act requires that work on the road shall begin within six months and be completed within 24 months after the passage.

MISCELLANEOUS NOTES.

A Donation by the Late Mr. M. G. Plante.—Mr. Planté, of accumulator fame, left a legacy of 1,500 francs (about $300) which is to be given as a prize to the person who makes an important advance in electrical science. News has just been received that the French Academy has agreed to accept this legacy.

The King Bridge Company, of Cleveland, of which Mr. Harry W. King is secretary, is prepared to undertake the erection of iron structures for electric light companies, and bridges, etc., for street railway companies. The King Bridge Company enjoys an excellent reputation for thorough and conscientious work.

Fireproof Insulation.—In reply to various inquiries Mr. Reginald A. Fessenden, Professor of Electrical Engineering at Purdue University, states that the process of making fireproof insulation described in an article by him in THE ELECTRICAL WORLD of Sept. 3, 1892, was completely covered by patent several years ago by Mr. Edison, as was implied in that article.

The Elliott Electric Company, of Cleveland, O., composed of Messrs. W. H., S. K. and J. E. Elliott, makes a specialty of rewinding armatures and doing work of that description. The Short company turns over to the Elliott company all the rewinding of armatures that comes to it. The Messrs. Elliott have had an experience of many years in this line in Cleveland.

Electro-Metallurgy.—In our last issue the series of articles on "Electro-Metallurgy" was concluded but not completed, the author's time being absorbed by practical professional work. The thoroughness with which both the scientific and practical parts of the subject were treated will make the work when finished a complete manual for the use of students of metallurgy, because this special part of the science has as yet no representative in the technical scientific literature at their command.

LEGAL NOTES.

Injury of Insured Property by Lightning.—Where in an action on a policy of fire insurance, which covered direct loss by lightning and excluded loss by windstorms, it appeared that a barn was prostrated in a windstorm accompanied by lightning, and, while there was no ignition, there were evidences of the presence of heat and injury by lightning, the question as to how much of the injury was caused by the wind, and how much by the lightning, was peculiarly for the jury, and a verdict for $100 should not be set aside as inadequate. This decision was rendered in the case of Beakes v. Commercial Union Assurance Company in the Supreme Court of New York.

Reformation of Telephone Contract.—In a suit to restrain a telephone company from removing a telephone from a banking house, where it appeared that there was a written contract by which the latter promised to pay for the service at a certain rate, but it claimed that after a specified time it was to pay only "regular rates," which were much less, and was evidence tending to show that the preliminary negotiations were on the basis of "regular rates" after a certain date, the court would reform the contract on the ground of mutual mistake, and grant an injunction. This decision was rendered in the case of the Martinsburgh Deposit Bank v. Central Pennsylvania Telephone and Supply Company in the Supreme Court of Pennsylvania.

The Commissioner of Patents on June 23, 1892, rendered a decision sustaining the examiners-in-chief in the case of Morford vs. Carpenter, which had been appealed from the examiners-in-chief. The appeal was with reference to the following interference issue: "In an electro-heating apparatus, the combination with the heated surface plate and the resistance of a coating of enamel or its equivalent securing the resistance to but insulating it from said plate." The commissioner sustained the decision awarding priority of invention to Morford. Carpenter's application was filed several months before that of Morford, but it was shown by witnesses and by original sketches that Morford had not only conceived the idea but had actually constructed an enamel plate two months before the application of Carpenter. The Morford patents are controlled by the Enamel Insulator Company, of Chicago, of which Mr. Geo. Cutter is general manager.

Industrial and Trade Notes.

The Commonwealth Electric Company is having good success with its small motors, which the company makes a specialty of.

Whitney & Sons, of Philadelphia, Pa., street car wheel manufacturers, are furnishing J. G. Brill & Co. with wheels for a Baltimore contract.

The Consolidated Electrical Manufacturing Company, Boston, has recently brought to the attention of the trade its new lightning-break knife switch.

The F. E. Belden Mica Mining Company has recently added a mica grinding machine to its plant, and will be in a position to receive orders for ground mica after Nov. 1.

The Bay State Belting Company, Boston, is manufacturing what it calls its Indian tanned oak belting, and claims that it is admirably suited for electric lighting and power purposes.

S. W. Lord & Co., of Philadelphia, Pa., manufacturers of Lord's boiler compound, have recently received some large orders for it. This compound is becoming very popular among steam users.

The LaRoche Electrical Works, of Philadelphia, Pa., recently received several orders for its large dynamos. The company is working overtime in order to keep pace with the increasing demand.

The Genett Air Brake Company, 150 Broadway, New York City, is very busy just now with the large contracts it has on hand. It is equipping the 125th street cable road with its brakes, as well as roads in Denver, Buffalo and Chicago.

The Pettingell-Andrews Company, of Boston, Mass., has found it necessary to keep its employés working night as well as day in order to fill orders. The company reports business in its various lines for the past month as being satisfactory.

The Washburn & Moen Manufacturing Company reports that insulation tests of "Salamander" wire made by the Massachusetts Electrical Engineering Company, of Boston, show 5,000 megohms resistance after ten days immersion in water at 80° F.

The B. F. Sturtevant Company has recently installed a complete heating plant for the Minneapolis Street Railway Company. This company's business is international in its character, as it is daily in receipt of orders for its blowers, engines and other manufactures from every country in the civilized world.

The Electric Railway Engineering Company, 180 Summer street, Boston, Mass., announces that it has secured a corp of competent engineers and is prepared to enter the field of the design and construction of power plants for electric railways, lighting stations, steam and water plants, etc., and no doubt will meet with success in its line of work.

Mr. Georges d'Infreville, 431 Canal street, New York City, is overrun with orders for his new "wasteless zincs" for batteries and has recently received large contracts from the Postal Telegraph Company, the Del. & Atlantic Telegraph and Telephone Company, the Kings County Elevated Road, Brooklyn; Prof. Elihu Thomson and the Kinsman block system.

Maris & Beekley is the firm name of the successors to the Maris Machine Company, who will continue the business of manufacturing cranes of all descriptions, overhead tramways, Teal portable hoists, trolleys, etc., at 2,343-2,345 Callowhill street, Philadelphia, Pa. Frank Maris, Chas. E. Maris and Wm. M. Beekley are general partners and Richard H. Chapman special partner of the new firm.

The Eclipse Clutch Works, Beloit, Wis., have secured the contract for the engines to be used in the electric plant of the Chicago City Railway Company, which has adopted the Westinghouse system for its side lines. The engines will be of the Wheelock type, but built in Beloit, and an important and interesting feature will be a new form of rope drive which the Eclipse Clutch Works will also install.

The Buffalo Street Railway Company has recently placed with the Standard Underground Cable Company, of New York City, an order for 50 miles of heavy underground feeders, the outside to be protected by braid thoroughly impregnated with the P. & B. insulating compound, which is manufactured by the Standard Paint Company, 2 Liberty street, New York. This is one of the largest single orders ever placed by an electric street railway company.

The Standard Electric Lighting Company is the name of a new electric company very recently formed and located at 2,246 and 2,248 North Ninth street, Philadelphia. This company makes a specialty of manufacturing electrical novelties, one of which is the Standard automatic time cut-out, which can be used on arc and incandescent circuits. This instrument will automatically cut off the light at whatever time it may be set, thus recording the exact period of duration of the light.

The Henry C. Hunt Company, of 45 Arch street, Boston, has recently received an order from Oliver Ames & Sons Corporation, North Easton, Mass., for a double leather belt, 97 feet long and 28 inches wide, to take the place of a belt that the Hunt people furnished this company 40 years ago. In the letter Mr. Oakes A. Ames expresses the hope that the new belt will give as good satisfaction as the one it replaces. This would appear to be very flattering to the grade of belts made by the Henry C. Hunt Company.

H. M. Sciple & Co., of Philadelphia, Pa., received the following orders last week: From the Brightwood Street Railway Company, of Washington, D. C., three 66 × 18 ft. return tubular boilers; one iron stack 72 in. by 80 ft.; two 200-h. p. compound engines; one large countershaft with Hill clutches; three 66 × 18 ft. return tubular boilers, etc., including one 600-h. p. Hamilton Corliss engine for the Huntington Street Railway Company, of Huntington, W. Va.; three 66 × 18 ft. return tubular boilers for the M. C. S. G. & A. Railway Company, of Pennsylvania.

Wm. Gardam & Son, of 98 John street, New York, still continue to turn out beautiful and accurate models. Among their last outputs was a very handsomely finished one-fourth size model of a street railway motor truck for the Brownell Car Company of St. Louis. They have several models pertaining to street railroading and embodying new ideas in process of construction at their factory, which it is to be regretted will not be finished in time for the coming convention. For experimental work of all kinds, models of inventions, specialties, etc., for both commercial and litigation purposes, the work done by the Gardams is excellent.

The Jordan Electric Train Signal was recently given a trial at Portland, Me., in the presence of the directors of the Maine Central, Grand Trunk, Boston & Maine, Portland & Rochester, Boston & Albany, and Santa Fe railroads. This device is intended to replace the old bell rope which runs through all the cars to connect with the locomotive; instead an electric wire runs from the engine to the rear of the train, a battery is placed on the engine and electric push buttons at convenient places throughout the train. By this means the conductor can communicate with the engineer by a system of signals similar to those in use in telegraphy.

The Brush Electric Company, of Cleveland, O., through their agents S. W. Trawick, of Atlanta, Ga., and A. D. Dorman, of New York, have just closed a contract with the Mutual Light and Power Company, of Montgomery, Ala., for a complete central station plant, the consideration being considerably in excess of $100,000. The equipment is to consist of 300 arc lights, 2,500 16-c. p. incandescent lights, 70 h. p. of generators, 700 h. p. of Hamilton Corliss engines, 700 h. p. of Heine Safety Water Tube boilers and all necessary shafting, friction clutch pulleys, couplings, etc., together with all construction work for arc, incandescent and power circuits. The contract for the complete steam power plant was awarded to the Heine Safety Boiler Company, of St. Louis, represented by S. C. Munoz. The Heine company has sublet the engine portion of the contract to the Hamilton Corliss Engine Company, represented by J. A. Vail, of St. Louis. The complete plant must be installed and in operation by Jan. 1, 1893. Mr. Dorman has just closed a contract with T. S. McLachlin, of Whitehall, N. Y., for a 90-arc light plant of the Brush system.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

The Electric Engineering & Supply Co., Syracuse, N. Y., hereby withdraw all quotations on goods of their manufacture. New quotations furnished on application.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

A World Beater.—We have downed the Perfection Oil Purifier, of New York, and the Phœnix Oil Filter, of Racine, Wis., in competitive tests with our Automatic Ideal Steam Oil Refiner. Send for catalogue to Purity Oil Filter Manufacturing Company, 900 Water street, Pittsburgh, Pa.

Where to Locate New Factories is the title of a 150 page pamphlet recently published by the Passenger Department of the Illinois Central Railroad, and should be read by every mechanic, capitalist and manufacturer. It describes in detail the manufacturing advantages of the principal cities and towns on the line of the Southern Division of the Illinois Central and the Louisville, New Orleans & Texas railroads, and indicates the character and amount of substantial aid each city or town is willing to contribute. It furnishes conclusive proof that the South possesses advantages for the establishment of every kind of factory working wool, cotton, wood or clay. For a free copy of this illustrated pamphlet address Mr. J. Merry, Assistant General Passenger Agent I. C. R. R., Manchester, Ia.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

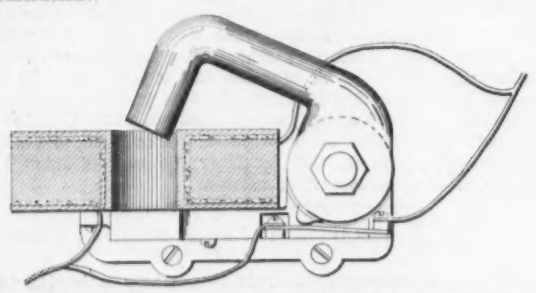
U. S. PATENTS ISSUED OCT. 11, 1892.

484,068. Railroad Signal; Eugene Urbain, Brooklyn, N. Y. Application filed Oct. 20, 1871. An electric signal comprising a series of electric lights and bells arranged alongside the track, circuit-closing contacts connected with the lights and bells, and placed adjacent to a track rail, vertically and longitudinally movable levers arranged in pairs placed near the track in the path of the car wheels, the levers having oppositely extending inclined upper faces, and means for operating the circuit-closing contacts by the movement of the levers.

484,077. Rosette; Charles Wirt, Chicago, Ill. Application filed Aug. 29, 1891. In a rosette, the combination of a cap with recesses therein with circuit closers consisting each of a head cemented into such recesses, and separated outer ends between and about which the local conductor may be twisted and secured.

484,096. Galvanic Battery; John W. Hoffman, Chicago, Ill. Application filed Dec. 12, 1891. A galvanic battery comprising a zinc cup or cell provided with a plastic lining of starch and an excitant, a moistened filling of crushed coke or carbon, and a depolarizing agent, and a carbon stick or plate embedded in the filling.

484,110. Apparatus for Regulating the Intensity of Incandescent Lights; James F. McElroy, Albany, N. Y. Application filed March 18, 1892. This invention consists of an iron frame, an electric coil secured to the frame and so constructed as to allow a free circulation of air through the iron parts, an armature bent near its end in such a manner that the bended portion may be placed within the coil passing through the centre thereof, coming into contact with the iron frame on the opposite side of the coil from which it entered, the armature fulcrumed to the iron frame and provided on its lower portion with a lug, a spring attached to the iron frame, which will be operated upon by the lug when the armature enters the coil, the movement of the spring when operated by the lug breaking the circuit. (See illustration.)



No. 484,110.—Apparatus for Regulating the Intensity of Incandescent Lights.

484,120. Secondary Battery; William L. Silvey, Lima, O. Application filed Jan. 29, 1892. The process of initially preparing secondary battery plates, which consists in mixing a suitable metallic oxide with a liquid, placing the resulting paste on a suitable support, subjecting the oxide to the action of heat and pressure, and then pickling the whole in an acid solution. (See illustration.)

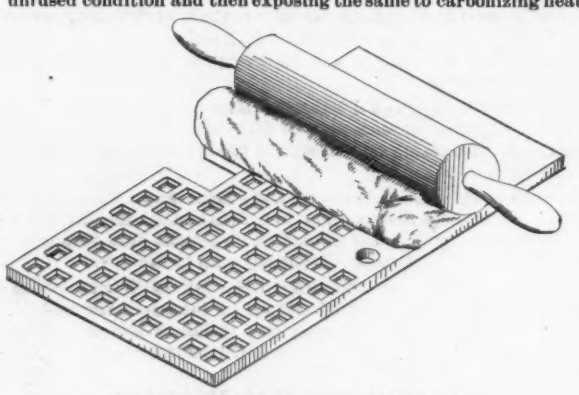
484,140. Electric Fire Alarm; Harvey Cortland, Toronto, Canada. Application filed April 30, 1892. In combination with a double-acting thermostat, main and branch circuits controlled thereby, relays in the circuits, local circuits controlled by the relays and containing alarm instruments, and a switch mechanism controlled by one local circuit and acting to open it and close the other.

484,150. Magnetic Telephone; Charles Stewart Forbes, London, England. Application filed May 16, 1892. The combination of the compound ringing magnets having soft iron pole pieces carried by one end with a tympan box and tympan and adjustable polar extensions, each carrying an inducing bobbin filled with a conducting wire connecting line and earth, and the generator at the reverse end.

484,182. Method of Electrical Refrigeration; Mark W. Dewey, Syracuse, N. Y. Application filed Feb. 3, 1890. The method of electrically cooling, consisting in cooling or lowering the temperature in a portion of a suitable electric conductor and passing an electric current through the conductor to increase the conduction of heat from the warmer portion of the conductor to the cooled portion.

484,183. Electrical Depositing-Meter; Thomas A. Edison Llewellyn Park, N. J. Application filed Sept. 2, 1891. The combination in a depositing meter of a cell, an electrolyte and two electrodes therein, one electrode being of such form and arrangement that parts of it stand on opposite sides of the other electrode, whereby the current may be measured by the weight of the metal deposited or removed from the electrode.

484,184. Manufacture of Carbon Filaments; Thomas A. Edison, Llewellyn Park, N. J. Application filed Oct. 27, 1886. The improvement in the method of carbonizing filaments for electric lamps, consisting in placing the bare filaments in a chamber, together with a quantity of lead or other fusible material in its unfused condition and then exposing the same to carbonizing heat.

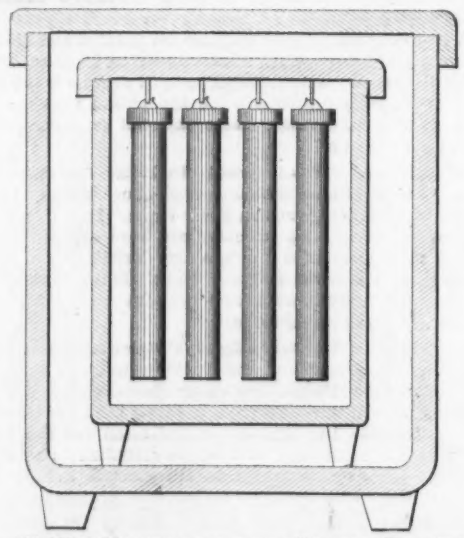


No. 384,120.—Secondary Battery.

484,185. Manufacture of Carbon Filaments; Thomas A. Edison, Llewellyn Park, N. J. Application filed Dec. 27, 1886. The combination, with the receptacle containing the filaments and infusible heat-conducting powder, of the chamber for receiving same, and means for suspending the receptacle in the chamber out of contact with the walls. (See illustration.)

484,199. Electric Arc Lamp; Joel A. Hayes, Carson City, Nev. Application filed June 27, 1891. In an arc lamp, the combination, with a casing surrounding the solenoid, of a conical casing terminating the same, surrounding the upper carbon, and provided with holes covered by an inner sliding conical shutter, and a tube projecting downward from the conical casing and supporting the lower carbon holder.

484,205. Apparatus for Indicating the Positions of Railway Cars; Joseph H. Hunter, Pittsburgh, and John S. Lucock, Allegheny, Pa. Application filed June 24, 1891. In an indicator, the combination of a chute divided into sections by annular perforated partitions, an electromagnet for each of the sections, the electromagnets each having an armature upon which are mounted two curved arms concentric with the holes in the annular partitions.



No. 484,185.—Manufacture of Carbon Filaments.

484,206. Device for Preventing Accidental Closing of Electric Circuits in Signal-Boxes; William H. James, Boston, Mass. Application filed Feb. 16, 1892. A signal movement comprising in its construction a stud, provided with a pin, connected with one pole of an electric circuit and insulated from the other pole, a movable part connected with the other pole of an electric circuit, and an actuated spring adapted to be connected with the arm and support the same in contact with the pin.

484,207. Incandescent Electric Lamp Socket; Charles J. Klein, New York. Application filed Dec. 28, 1889. The combination with an incandescent lamp and socket of conductors, a packing located between the neck of the lamp and the socket, a waterproofing material between the conductors and the bottom of the socket, and a clamping device.

484,208. System of Electrical Distribution; Harry Ward Leonard, New York. Application filed June 3, 1892. The combination of the main generator, the main lamps, low-volt storage battery in series with the main lamps, low-volt lamps in multiple arc with the storage battery, and an electromagnetic switch in the circuit of the low-volt lamps controlled by the current of the main generator. (See illustration.)

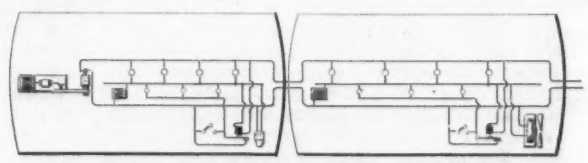
484,209. Insulator; Fred M. Locke, Victor, N. Y. Application filed July 13, 1891. An insulator shank having one end threaded and the other end solid and channeled longitudinally and corrugated transversely and provided with a central flange.

484,232. Portable Burglar Alarm; David D. Nolley, Wilson, N. C. Application filed May 25, 1892. A burglar alarm, comprising a battery, a bell, two contact points, one having two co-acting clamping arms for securing it to an object and the other having a screw and connecting wire.

484,233. Combined Electric Burglar and Fire Alarm; David D. Nolley, Wilson, N. C. Application filed May 25, 1892. A fire alarm, consisting of a battery, two wires side by side, connected with opposite poles of the battery, the wires being provided with a fusible insulation, and headed screws or tacks placed between the wires for holding them in place whereby when the insulation is burned the circuit is closed by the heads of the tacks or screws.

484,280. Trolley Wire Insulator; Albert Anderson, Boston Mass. Application filed Dec. 23, 1890. The combination, with substantially arch-shaped frames provided with enlarged portions to form a socket, and a clamping device secured to the insulator.

484,344. Trolley Wire Cleaner; Ernest B. Smith, South Amherst, Mass. Application filed Feb. 26, 1892. The combination of a trolley pole with a frame pivotally attached thereto, a contact pulley mounted in the frame and a clearing device mounted in the frame.



No. 484,208.—System of Electrical Distribution.

484,375. Railway Train Telegraph; Matthew B. Reiley, Washington, D. C. Application filed Jan. 4, 1888. The combination, with line conductor having spring arm connections covered with metal section plates supported upon the roadbed, of magnets secured to the under side of a vehicle near its ends, a part of which are in continuous contact with and the other part moving over the plates covering the conductor, the magnets being connected by a conductor passing through an instrument in the vehicle.

484,380. Electric Switch; Milton R. Utley, Minneapolis, Minn. Application filed March 5, 1892. The combination, with a base and binding posts, of a pivoted lever carrying contacts on its shorter arm and having the upper portion of the end of its shorter arm rounded, and a flat spring arranged to bear against the end of the shorter arm to hold the lever in different positions of adjustment.

484,385. Battery Compound; William Wright, New York. Application filed Dec. 2, 1891. The process of making a dry chemical sand or granular composition, which consists in subjecting sulphuric acid containing a metallic oxide and a chromium compound to a temperature of 275 degrees Fahrenheit for 15 minutes and then spreading the same upon a plate cooled to 60 degrees Fahrenheit to become dry and granular.

484,405. Electric Cable Splice; Frederic A. C. Perrine, Trenton, N. J. Application filed June 29, 1891. An unfilled electric cable splice having each spliced conductor surrounded by a sleeve of non-absorbent paper or similar non-absorbent material, and having a casing outside the group of spliced conductors.

484,123. Electrically Operated Railway Switch; Charles A. Stone, Newton, Mass., and Edwin S. Webster, Boston, Mass. Application filed Sept. 25, 1891. In combination with an electrically operated railway switch, a switch section electric conductor connected with an electro magnet of the railway switch through an independent circuit, which circuit is adapted to be interposed in the main circuit between the motor and the source of electrical supply.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.